TRANSACTIONS

OF

The Philosophical Institute

OF

VICTORIA.

TRANSACTIONS

OF THE

PHILOSOPHICAL INSTITUTE

OF

VICTORIA,

FROM AUGUST, 1855, TO DECEMBER, 1856, INCLUSIVE.

VOL. I.

Edited for the Council of the Institute by

JOHN MACADAM, M.D., Hon. Sec.

Melbourne.
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PHILOSOPHICAL INSTITUTE OF VICTORIA.

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NOTE.

Professor McCoy's Paper on "Museums in Victoria."

The Continuation of Professor McCoy's Paper has been omitted from this volume of the TRANSACTIONS, by order of the COUNCIL, because, as furnished to the Honorary Secretary, it contained matter not yet read before the INSTITUTE.

TRANSACTIONS

OF THE

Philosophical Institute of Victoria.

Anniversary Address of the President, the Honourable Andrew Clarke, Captain R. E., M.P., Surveyor-General of Victoria, &c., &c., &c.

The office of your President requiring qualifications I am aware I do not possess, and being ordinarily occupied in the discharge of official duties requiring all my time, I fear I shall be able to add but little to the proceedings of a Society which can be made the means of great benefit to the country, yet let me assure you that my hopes will not be the less sanguine, or my efforts the less ardent, to place your Institute on a basis which will command support and respect.

It now becomes my duty briefly to revert to the past history of the two societies, the union of which we are met here this evening to cement.

Though the past efforts of both have not been unworthy of their object, they have fallen far short of what we can hope to attain for the future by their combination. When I had the pleasure of addressing the first meeting of the Philosophical Society, its members were few, and it had a powerful rival in the Victorian Institute. It seemed then as though there were insuperable difficulties to their amalgamation, but connected as I have been from the first with both, it was always my earnest desire to see consolidated the strength and energy of the two Societies.

The circumstances of the country indeed precluded the possibility of two such Societies existing successfully, and as this became more evident it was proposed to effect their union on a wide and permanent basis.

The management of this was entrusted to committees of the Council of both, and I have to congratulate the gentlemen forming those committees on the temper and prudence they exhibited in conducting the arrangement to a successful conclusion.

United as we now are, and receiving accessions of new members, our means of useful exertion are greatly increased.

If we are firm to those principles which past experience has shown to be best for scientific bodies, we need entertain no fears that our efforts will be misconstrued, or that the public will long remain indifferent to our pursuits.

Notwithstanding the difficulties to which I have alluded, the advance of both Societies has been rapid, the results of their labours valuable.

Established at a period when Victoria had already occupied the first place in the southern hemisphere, we were sanguine of a brighter success, of more earnest endeavours, of more extensive research, than I can truthfully attach to our efforts. But that they have not been futile—that they have not been unworthy of the country—is manifest in the valua-

ble original papers which have from time to time called forth the interest and approval of the members. And not only in this form have members presented the results of their application.

The science of geology has been extended by the collection of many hundred specimens of rocks and fossils illustrative of the formations which occur in a gold-producing land. They have been gathered from widely extended localities, and are often accompanied by remarks and descriptions which add a ten-fold value to such records.

Our botanical knowledge has been largely augmented by the arrangement and display of many new species of plants, some of which, it is believed, will become useful in the arts and in medicine. Beautiful specimens of timber have been exhibited of kinds hitherto little known, and the limits of the geographical distribution of plants in this, the most southern part of Australia, have in many instances been recorded. For these we are almost wholly indebted to the brave and simple-hearted Ferdinand Mueller, whose courage and devotion has led him, unaided and unrequited, to seek in hostile and deadly regions, new objects of peaceful conquest. I am sure I am expressing the feelings of all in cherishing the hope that he may return unharmed from his self-denying and dangerous task, to aid us by his counsels, and to add fresh memorials of his eminent abilities to our records and museum.

The meteorology of Victoria has become the subject of attention to many observers, and is now being made the object of systematic organisation, with the view of extension to the other colonies of the Australian group.

The value of these results alone in guiding improvements in our sanitary and material progress cannot be over estimated.

To the nucleus of a national museum have been added

many valuable contributions. And whilst all these have received a proportionate share of attention, there have not been wanting practical men who have brought special acquirements to bear on subjects of a more limited character;—local in their application, but general in their importance. The engineer, not content to follow blindly the beaten track of his predecessors, has brought to light new and useful facts in architecture, in road works and hydrometry; and while discoursing of abstract principles, which are at once his guide and the result of former application, he has not forgotten that his works are to be valued rather by the measure of their utility than as additions to science.

In reviewing past exertions I would more willingly draw your attention to such of them as have been successful, but if I adopted this course I should ill discharge the task which is allotted to me.

If success has attended those things wherein we had chiefly to rely on our own energies,—for the accomplishment of which there was needed no extraneous aid,—we have failed, and failed lamentably, when we have had to look for assistance to those who reap a certain benefit—in some cases directly in others indirectly—from the works undertaken by this Society.

It will be in your recollection that in September, 1854, it was proposed to organise a system of exploration with the hope of discovering and rendering available the mineral wealth of the colony. That system, after being carefully considered by a committee to inquire into its merits, was unanimously adopted at a general meeting of the Philosophical Society. Its aims, however, being utterly beyond the power of a young society, it was determined to appeal to the Governor and Legislative Council for assistance. The scheme itself was so extensive that it was necessary, in stat-

ing its objects to the Government, to limit it in some measure to the absolute requirements of the colony.

It may be as well here to repeat the reasons which led the society to believe that had this scheme been undertaken it would have benefited the country at once, and in the manner most needed. More than now our knowledge of the physical character of the province was circumscribed. Efficiently organised exploring parties would have supplied the information in an acceptable form. The discovery of an available coal-field is necessary to our prosperity as a commercial people, and as coal is known to exist here, especially at Cape Patterson and on the Cape Otway coast, this, under proper superintendence, might ere now have been accomplished.

We know little accurately of the real extent of the auriferous districts of the colony, but what little is known leads to the belief that careful and searching inquiry, and that not protracted nor involving any large pecuniary outlay, would destroy many gross delusions existing on this point, and possibly, by showing the true nature of auriferous deposits, induce the miner to work on better and more economical principles. Recent events have proved still more how correct was the view we then formed on this subject.

Materials for building purposes are so scarce here, or rather are considered of so poor a quality, that freestone has actually been imported from Tasmania, and yet it is believed by many practical men that much good freestone may be obtained even in this district.

These, and subjects of a kindred character, would have been inquired into by exploring parties, and even had one discovery of such a nature rewarded their toil, it would have been an ample recompense for the outlay we had proposed to ourselves.

Though all these researches have been admitted to be of

vast importance in the national advancement of Victoria, the indifference of the colonists, and the apathy of the Legislature, led to an abandonment of the scheme.

Let me not, however, be misunderstood in what I have said. I do not advocate the adoption of state aid or state organisation for institutions like this. I do not believe they would harmonise with our social or political character. In this as well as in many other associations, experience has proved that in British communities, the voluntary efforts of individuals have rendered more essential service than the cold, and too often ungracious, vote of a Legislature, whose views, frequently narrowed within the prospect of an immediate result, cannot recognise the gradual steps that must be taken even by the bold and original, though still cautious enquirer. The extreme indifference towards those things which do not promise immediate and certain pecuniary profit or advantage, is an evil the effect of which will extend to the next generation.

It is the peculiar duty of an institution like this to combat this evil as powerfully as it can, and to censure as strongly ; but it would be unjust to attach an undue share of blame to individuals, or to a small section of the people, for what is unhappily too marked a feature in our whole social system. The failure of the scheme but illustrates the spirit which pervades all classes, and though we may cheerfully look forward to a period when Science in Victoria shall have her temples and her worshippers, these will not be numerous or wealthy, until the people have learned, by costly experience, that to neglect her admonitions, is to neglect the best sources of prosperity.

Events have shown that if we continue unmindful of the means of wealth which are open to us, if we depend exclusively upon our neighbours for those substances without which the arts cannot exist, Victoria must give place to those more enterprising countries.

Already in New South Wales the manufacture of iron has, I understand, become an important branch of industry,—and unlike the precious metals—where iron is found in abundance—there material prosperity is attendant upon national industry and steady endeavour. Unlike a search for the more glittering ores, it is permanent. It never dazzles us with the promise of enormous and rapidly acquired wealth, and it never disappoints the wise enterprize of the experienced. Abundantly favoured with extensive auriferous fields, let us endeavour to divert the labour of the immigrant from such a channel, and chiefly lend our aid to better, because more enduring operations.

Independent of our extensive auriferous fields, it may be presumed that we have at hand in our coal and our iron ore the elements of a prosperity to which the wealth of the gold mines is insignificant. Shall these be neglected because the gold mines are not yet exhausted? On the contrary, should we not endeavour the more actively to construct a lasting foundation on which the prosperity of the country may rest secure.

I am the more inclined to press these views upon the members, because outside there is a tendency to view the gold districts of the colony as the only means of support to a large population, as the sole resource which is open to the enterprize of the industrious.

It is not my opinion that the auriferous lands are in any locality exhausted, or that they will suddenly cease to reward the labour of the miner. On the contrary, I believe that as science, machinery, and capital, are brought to bear on the extraction of gold from the matrix, and its separation from the alluvium, we shall have a larger and a steadier yield, and consequently larger and more certain earnings to the miner.

Though this view of the case is so far satisfactory, let us not forget that gold alone will not help us with our railroads,

—that it cannot with profit be exchanged for coal and iron and manufactured goods.

It is certain that this yield increases at the expense of every useful manufacture, and that the country which depends upon this alone will soon retrograde, and be left far behind in civilisation, in arts, and in refinement.

In seeking to connect the sciences with the practical business of life, there are many prejudices to be overcome, and much difficult ground to be broken up. Aware of this, we must be prepared for sacrifices on our part, but such as we need not shrink from if we look steadily forward to the beneficial results of even a partial success. Already has an advance been made in this direction. An institute of this kind in the midst of a people, strangers to each other, who have not yet begun to acknowledge, if they yet recognize, the ties which in the European world draw men into close connection, is not intended to compete with societies which have long been founded, which have reaped the labours of such men as Forbes and De la Beche, and are receiving continual accessions from many hands in all parts of the world. It is perhaps, in some instances, because of a comparison with such societies, that this Institution in Victoria has not received that cordial help which it has a right to claim. Those who have taken this view must not forget that the Royal Society of England had a commencement augurring ill for its future success. Established at a period when men's minds were divided between rejecting the teachings of science altogether, and attributing to such knowledge more than a miraculous power;—composed of men, many of whom were unacquainted with the simplest facts of science, which indeed were then only known to a few;—encountering fierce hostility from the most eminent persons;—suspected of conspiring both against religion and freedom;—it had a long struggle before it won public confidence.

Such difficulties as these we have not to contend against;

but the pursuits we ask others to follow and to support us in, have never yet been properly recognized, or their importance practically admitted. Natural history finds no place in our schools. The practical man has stood aloof from the man of science. The Manufacturer, the Artist, and Designer, have followed the dictates of empirical practice, and have rarely, till of late years, lent a patient ear to the simple truths taught by the Chemist and the Geologist. And is it because the sciences are remote from their pursuits? "I am not one "of those," says Forbes, "who would separate science from "the ordinary pursuits of men, or who would desire to see "philosophers withdrawing themselves from the multitude, "by keeping their thoughts unmingled with the meaner aims "of the crowd. When Science, provided she be mindful of "her honour, and makes no sacrifices of her love of truth, "serves as the handmaiden of even the humblest of arts, her "dignity gains in lustre, and her familiarity breeds respect. "There is no department of science without some ties with "the common business of life."

It is for us, in this country, to assert the high importance of knowledge, to bring before the people in an intelligible form, the truthful principles and the ascertained facts which ought to guide the Architect, the Miner, the Agriculturist, and the Engineer. That this is not beyond our ability, is proved by the works which have emanated from the Society.

In the establishment of a museum we have the elements of much good. It is not to be a mere collection of curiosities, serving rather to bewilder than to instruct. It is not to contain specimens that are interesting only because they are beautiful. I hope to see in that museum a complete collection of all the ores that are useful, of all the woods that are suitable for shipbuilding, for roads, and for tramways. There should find a place a large assortment of all stones that can be usefully adapted to architecture, with correct descriptions of the localities from whence they are procured,

with a statement of their durability and qualities. I desire to see the museum filled with all those objects that are peculiarly valuable in a new country, to the exclusion of merely ornamental specimens.

In carrying out these views the members of the Institute can each assist in some department; and as all the contributions will be carefully preserved, it should be a subject of pride to each, to add to these records of the country's progress.

The Observatories hitherto established, restricted yet in their operations, are not less practical than the museum. The progress that has already been made in the compilation of meteorological tables is highly satisfactory, and a record of the rain fall and the variations of the thermometer, taken at suitable places throughout the country, will, I trust, be added. The information gained from these—though still limited and insufficient—will go far to settle many doubtful points which perplex the man who is about to settle as an agriculturist. To the farmer the truth respecting the climate of any particular district is obviously of the greatest importance.

In advocating very strongly that the labours of the members of the Institute should be essentially practical, I do not wish to be supposed to underrate the labours of those who devote themselves to the study of abstract truths; nor would I disdain the humblest aids which we can all give to our common object. Some can gather and arrange the raw material, the facts and observations which shall proclaim and explain the existence of new and unknown laws; others can collect the fossils and rocks from which the geologist can frame a history of the world, or the minerals which the Chemist in his laboratory can convert to high and important purposes of life; but more than all, and above all, we can by kindly help and cordial co-operation, cheer the solitary student in his labours, and be the assurance of the warm sympathies of his fellow-men.

Art. I.—*On a Viviparous Fish from Hobson's Bay.* By Ludwig Becker, Esq.

In the beginning of last month (August, 1855) I found in a fishmonger's shop in Melbourne, a small fish, which, on account of its peculiar shape, I deemed worth dissection.

On opening it, in order to examine the contents of the stomach, to my astonishment I found a true womb containing a multitude of young fishes, the offspring of the larger fish.

In the Year Book of Facts for 1855, in an article headed "Extraordinary fishes from California," is a description of two fishes purported to bring forth their young alive, which have been recently forwarded for examination to Professor Agassiz. That eminent naturalist considered them to belong to a new genus, which he proposed to designate by the term *Embiotica*. Further particulars concerning these extraordinary creatures may be seen in the American Journal of "Science and Art," XXI., and in "Jameson's Philosophical Journal," 114; but as I am unable to obtain either of these periodicals here, in offering this description of my Hobson's Bay fish, I must undertake the risk of either repeating something already known or stating not sufficiently clear that which is yet unknown.

The fish I am about to describe lives at the mouth of the Yarra, in shallow water amongst sea plants. It varies from five to six inches in length, and in general is of a greenish brown colour, though somewhat brighter on the belly. The fins, which are light brown, are more or less sprinkled in the course of each ray with markings of dull pink. Eyes greyish, with four to six radii, with the pupil bordered by a fine red line.

The whole body is speckled over with small black dots, and the back, down to the middle of each side, is marked by a series of dark stripes. The fins are four in number, viz.,—The dorsal, anal, caudal and pectoral. The dorsal fin contains thirty-nine rays, which, with the exception of the first

three and last four, are all spinous. The anal fin is composed of twenty-six, the caudal of twelve rays. The pectoral fin of the female has thirteen, while that of the male has only twelve rays. These fins are all soft.

Two well-developed beard-like branched excrescences fall from the throat, representing the ventrals, and there are also other thready appendages above the eyes and below the nostrils.

Both jaws contain a large number of minute and sharp teeth.

The scales are so small as to be scarcely visible to the naked eye. When magnified, however, they exhibit the forms shown in the figure (see Fig. g). The fish is, with the exception of the belly and part of the head, completely and uniformly covered by these scales, there being no interruption like that which Agassiz found in the Californian species, a peculiarity on account of which he proposed to call it *Halconoti* if the name "Embiotica" was found to be inappropriate.

The liver (C) covers the stomach, the heart (D) being concealed between them. Slightly attached to the back of the fish, by thin band-like filaments, is the uterus or bag (B), connected with the hinder part of the intestines (A). The womb consists of a very thin and transparent skin, of a faint blueish colour, and, in the specimen which I opened, it contained upwards of two hundred young, in various stages of development, from the simple egg to the perfect fish (*vide* figures 1, 2, 3, 4 and 5). The young, when in the form represented in figures 1, 2, 3, were enveloped in a bag or caul, which contained a fluid. By experiment I found that the young fish in the uterus is born as soon as it has arrived at its greatest perfection; thus allowing room for the further development of the other half-grown creatures in the womb. The young fish at its birth is almost as perfect as its parents, but differs from them in colour, being almost white, and is characterised by the absence of the dorsal and caudal fins. It possesses, notwithstanding, an active power of locomotion, and swims vigorously about in its new element as soon as born. A few days after birth the hitherto wanting fins (which, while in the womb, were indicated by a row of black spots) begin to be perceptible, and the colour of the young fish become considerably darkened. On pressing the abdomen of the old one, ten or fifteen young fishes were squeezed out, which made living motions in the hand, and swam immediately on being placed in sea water; but others

A
C
B
D

not perfectly developed, on being pressed out, immediately sank to the bottom. In the parent fish no air bladder is observable, but the whole womb, with its contents, floats in fresh water and sinks in spirits of wine.

The young fishes swim in shoals, and are alike remarkable for their activity and shyness. The eyes of these little uterine animals are unusually large; they are as brilliant as the finest opals, and may be observed to glisten, not only through the uterus, but even through the skin and scales of the mother.

I received for examination a few specimens of fishes in various stages of growth. They had been more than eight hours out of water, being packed amongst shrimps in a basket, but notwithstanding this, on being returned into sea water, they swam about as vigorously as though they had never been out of their element. When out of water the head of the fish is bent convulsively upwards; the gills are blown up, but kept close to the body at their edges, and partly covered by the pectoral fins, which are turned over in a forward direction. It is thus, I am of opinion, that the fish is enabled to retain in its gills sufficient moisture to prevent their drying up for a very considerable time. In addition to this the gill filaments are so arranged that they do not clog together, a peculiarity which recalls to my mind the *Anabas* or Climbing Perch of Tranquebar, which is known to ascend bushes and trees in search of its prey.

The fish may be obtained in abundance in Hobson's Bay and at the mouth of the Yarra, but it is in no demand, as its small size renders it of very little value as an article of commerce. Whether it is plentiful at this particular season only, or has merely resorted to the locality named for the deposit of its young, and later in the season will become more scarce; whether other species of these animals exist in the waters of Australia;* whether my fish is related to those discovered in California, or belongs to the genus Blenny, I shall investigate and hereafter make known.

As an ichthyological curiosity, however, it seems to me worth the short description and sketch which I have now the honour to hand over to the Philosophical Institute.

Melbourne, 5th September, 1855.

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* Since the above was written I found in Hobson's Bay four other species of Blennys, all of them viviparous.—Melbourne, January, 1857.—L. B.

Art. II.—*On a Sygnathus from Hobson's Bay.* By Ludwig Becker, Esq.

While occupied in Hobson's Bay in completing my observations about the fish which I have described in the preceding paper, I found, amongst many others in a fish net, a small pipe fish (Sygnathus).

This fish, like the preceding, lives among the sea plants; it is of a brown colour, with vertical stripes of the finest blue. The pectoral fin has ten, the dorsal twenty-five, and the caudal fin nine rays, all of them soft. The body is entirely covered by scale-like plates in sixty-one divisions.

Fig. 1 represents a female with eggs. The eggs are about one-sixteenth of an inch in diameter; they are deposited for fecundation in a pouch attached to the male (Fig. 2) at the junction of the body and tail. In this pouch, which is open and about one inch long, the eggs are developed; the young remaining in it till they are able to swim. In the pouch of the specimen which I obtained were thirty-three fœtuses, one of which I sketched, and it is represented, considerably magnified, in Fig. III.

The young were of a white colour, sprinkled over with black dots. The head is very thick, but the muzzle is not prolonged as in the parent fish. The remainder of the eggs are attached to the belly, forming as it were a kind of placenta. The dorsal and caudal fins were already developed, but the pectoral fin was not. The eyes of the young ones are very large and projecting. The specimen which I examined (by the microscope) dried up during my observations; the round worm-like body had shrunk and withered, and with the exception of the head and belly, had assumed almost as perfect a shape as that of the full grown fish.

The fœtuses above described were about half an inch long; they lay closely together in the paternal pouch, being slightly attached to the skin.

For the sake of illustration I have placed the different sections of the body (of full grown specimens) underneath their respective parts.

Although naturalists are well aware of the existence of pouch-bearing fishes, yet as the specimen which I now present to the Philosophical Institute may belong to a new species, I hope that this preliminary and imperfect notice may be accepted with kind indulgence.*

Melbourne, 5th September, 1855.

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* I have since found other species of pouch-bearing Sygnathi in the same locality. January 1857. L. B.

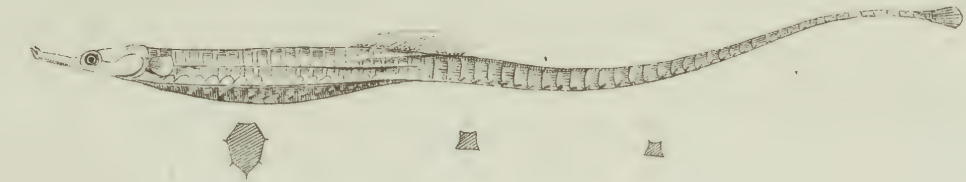

Fig 1.

Fig 2

Fig 3

Ludwig Becker del.

ART. III.—*On the Age of the Animal and Vegetable Kingdom of Australia relatively to that of the rest of the World; and some Remarks on the Changes of this Land by Upheavals. By* LUDWIG BECKER, Esq.

WHEN the earth had passed the Oolitic age, her physiognomy was again several times altered by the motions of the Chalk, the Tertiary, and Diluvial period; after which she underwent alterations apparently slower and less forcible than before, although the primitive powers still exerted themselves, and received besides a new ally in Man, the youngest creature of earth.

It seems, however, as if not all parts of the pre-Oolitic Earth-crust have, by later revolutions, been altered, covered, or swallowed up; but that it is granted to the human eye to study in our days the character of a landscape which even before the Chalk epoch gave shelter and nourishment to a series of creatures, of which, strange to say, a great part is still breathing. I am speaking here of Australia and her animal kingdom.

In the *Stonesfield slate*, in the *Jura limestone* at *Solenhofen* (which furnishes us with the well-known stones for lithography), and in other strata between the secondary system and the Chalk, we find remains of animals and plants that have still their living representatives in Australia. From amongst others I mention a creature similar to the opossum, the *Phascolotherium*, of which Buckland remarks :—" It is a proof that this order (Marsupialia) instead of being, as was once supposed, of more recent introduction than other orders of Mammalia, is in reality the first and most ancient condition under which animals of this class appeared upon our planet." And Professor Owen on the same subject says :—" It is interesting to observe that the marsupial genera, to which the above fossil quadruped, called Phascolotherium, was most nearly allied, are now confined to New South Wales and Van Diemen's Land; since it is in the Australian seas that is found the *Cestracion*, a cartilaginous fish, which has teeth that are most like those fossil teeth called *Acrodus* and *Psammodus*, so common in the Oolite. In the same Australian seas, also, near the shore, the beautiful shell-fish called *Trigonia* is found living, of which genus many fossil species occur in the Stonesfield slate. Moreover, the Araucarian pines are now abundant, together with ferns, in Australia, as they were in Europe in the oolitic period."

Among the insects which lie buried in the Jura limestone

we find a *Cynthia (cardui?)*, the representation of which is here in this country the most common butterfly, and nearly all the year round on its wings.

Of plants I shall mention *Polypodium*, found in a slate formation in Saxony, but alive in the Dandenong ranges; and species belonging to *Cycadeæ* are analogous to plants now natives of New Holland.

From this and other indications, it seems to me to result that *the existing Australian Fauna is the oldest living animal kingdom; that a great number of trees and flowers, planted in Oolitic times, are still blooming in Australia; and that the present external form of this portion of the earth is the oldest aspect of the earth preserved to these times.*

It might be suggested, however, that here are found remains of extinct animals, all of them more or less allied to the living marsupials, and of which some attained the size of a Mastodon. These so called tertiary and diluvial animals are of course older than the living Fauna; and the strata in which they are found are likewise older than the soil that now gives nourishment to the kangaroo, and such strata might therefore be contemporaneous with the lowest deposits of the Oolite (?), and are to the surface soil of Australia as the Pliocene and Diluvium are to the humus of Europe.

I will not say that Australia has been lying in inactivity since that ancient period; on the contrary, I shall try to prove that this large island, with some neighbouring smaller ones, is subject to *continual movement;* but this movement was, and is, such an imperceptible and gradual one, that it has no destructive influence on organic life. Volcanic evolutions and other disturbances of a mere active nature, appear to have been confined to spots comparatively small and isolated; and animals and plants soon spread over the new country again, from the undisturbed neighbourhood.

There was a time when Tasmania was attached to New Holland. A great marshy or swampy plain extended from Port Phillip to Port Dalrymple, and from King's Island to Flinder's Island. The eastern and western parts of that great swamp were bordered by chains of mountains, forming the highway for the animals. But all the animals of Tasmania and New Holland did not wander to and fro: there were some confined to Van Diemen's Land; for example—Thylacinus, Diabolus Ursinus, Perameles Gunnii, and others, preferring a cooler and damper climate; while the drier and warmer air of New Holland was preferred by others.

SECTION of BASS STRAIT EAST

But a time came when that great Southern Cape of Australia was separated by the deeper submersion of the extensive swamp, which is now, on the average, 240 feet below the sea, here called "Bass's Strait."

For illustration I have added a sketch, which represents the eastern part of this Strait. A Section from Cape Portland (V.D.L.) to Wilson's Promontary, shows the bottom of the sea, which is nearly a dead level.* The highest parts of the ancient highway are now islands. At the same time when this land was swallowed up, very likely Port Phillip and a great number of other Australian bays, lakes, etc., were formed. These submerged countries are now rising again, as we can see distinctly by the raised beaches; of which I will mention here only a few.

There is one between Cape Liptrap and Portland Bay, containing, amongst other shells, *Ostrea* of the present time. Another, on *Green Island* (Bass's Strait), which is raised 100 feet. Another on the south west coast of Flinders' Island, according to a well-known authority. Ten miles south from Cape Grim, and on the west coast of Van Diemen's Land, are likewise beaches 100 feet high. "The beds of these beaches are within the zone of clay of the second epoch, and in the vicinity of basalt and trachytic conglomerates." At Table Cape (north coast of Van Diemen's Land), 70 feet above the sea, is an elevated beach containing shells, sponges, and corals. Opposite George Town, near the mouth of the Tamar (V.D.L.), I found a beach elevated a few feet above highwater mark, and consisting of a hard conglomerate of sand, limestone, and shells of molluscs, which, at the present time, are found alive in the Tamar. This beach extends five miles from the river to the foot of the Asbestos Hills. A striking indication of uprising ground seems to me to be Lake Torrens, which was for a time merely an elongation of Spencer's Gulf.

It is not supposed that all these risings out of the sea happened contemporaneously, or that all our neighbouring coasts in their whole extent rose in the same progressive way: I believe, on the contrary, that the subterranean powers are possessed of different centres, all of which are not simultaneously in activity.

There will come an epoch when Hobson's Bay and Port Phillip will be again a swamp, and partly dry; and the mouth

* One vertical height is exaggerated about 208 feet in the mile of 5280 ft.

of the Yarra again between the Heads, similar to the mouth of the Murray in South Australia. "That river now flows through a lake (Victoria Lake) which, during the greatest portion of the year, is the receptacle of the fresh waters of the Murray itself. Before the land rose the river flowed through waters as permanently and exclusively salt as those of Hobson's Bay at this day."

Whether this epoch is near or far we can form no idea. Multiplied observations will be necessary before we are able to tell how many inches or feet the land has risen in so many years or centuries.

I have heard from the Surveyor-General of Victoria that six tide gauges are about to be erected in suitable places. By means of these we shall be able to ascertain how much the land is rising in a given time. But it is to be wished that all the Australian Colonies should erect similar tide gauges; and the observations thereon, in connection with the notes, made during and after an earthquake, ought to be mutually exchanged, after certain intervals of time. It is most important, both for science and practical life, to know on what ground each of them is standing.

Melbourne, Oct. 22, 1855.

Art. IV.—*On a Proposed Floating Railway Pier.* By Frederick Acheson, Esq., C. E.

(Abridged.)

In a great city like Melbourne, an object of primary importance must always be a ready communication with the vessels of all draught lying in its port, so that facility of discharge and loading may be obtained without the inconvenience and loss arising from frequent transhipment. To attain this end, various schemes have been proposed, embracing the construction of a ship canal and docks; deepening the river Yarra, so as to render it navigable for vessels of deep draught up to the Queen's Wharf; and, finally, the construction of piers from the Hobson's Bay and Williamstown Railways into deep water in Hobson's Bay. The merits of these various schemes have been often discussed, and it will therefore not be necessary to enter upon them here. I will simply state my own conviction, that were it practicable to construct a pier from either of the railways into deep water, so as to give sufficient frontage to vessels loading and unloading, such

would answer all required purposes, and render the construction of the ship canal and docks unnecessary, for I do not see much advantage gained by having goods discharged at once on the Melbourne wharves, instead of into a railway truck in Hobson's Bay, although further off; which latter plan has a decided advantage as regards the landing of merchandise destined for the interior, supposing the railway system complete. It, however, unfortunately happens that the practicability of efficiently constructing such piers in the Bay, is rendered extremely doubtful, owing to the assertion that the shifting character of its bed will not hold firmly the driven piles. The original design of running out a pier from Hobson's Bay Railway, has, therefore, been arrested in its execution before reaching the length necessary to render it accessible to vessels of large draught.

The Hobson's Bay Railway thus shorn of its fair proportions, necessarily fails to accomplish the great end for which it was designed, and never can be looked upon as a great benefit to the commercial interests of Melbourne, until its extension into the deep water has rendered it accessible to vessels of all draught, and ample frontage has been afforded.

Convinced as I have been for some time past that a railway pier, presenting great frontage to the deep water of the Bay, is the most legitimate plan for communication between the city and the shipping, and also best adapted for the discharging and loading of cargoes, I have given some consideration to the subject, with the view to ascertaining if such a scheme be practicable by other means than the pile system —I allude to the possibility of constructing a floating pier of such stability as to permit of the easy and safe passage of railway waggon-trains over it, and which shall be of a durable material and sound construction.

It is a simple matter to ascertain the effect produced upon any floating body by superincumbent weights: the depression consequent thereon can be exactly calculated; and were the depression in the water the only difficulty to be overcome in rendering floating lines applicable to railway transit, I would not doubt of success for a moment; but there are two other forces in operation, having a disturbing effect, namely, the rise and fall of the tide constantly changing the level, and therefore breaking with the permanent level of the rails on land; and also the frequently perturbed state of the adjacent waters, which communicate an oscillatory motion to all bodies floating on them. A pier thus at the mercy of the waves and the tides would be manifestly unsuited to the

purposes required, were its dimensions confined to reasonable limits. With obstacles like these last to be overcome, I consider the successful adaptation of floating piers in the ordinary form, and as hitherto known to railway purposes, exceedingly problematical.

Feeling, as I have long done, the great importance of the subject, I directed my attention some time back to the contrivance of some means of rendering floating bodies insensible to exterior forces, acting either laterally with a rolling motion, or vertically, and thus to attain a rigidity of position, as if on land, but of course within certain limits.

The depression in the water caused by placing a given weight upon a floating body, led me to the idea that a uniform level of immersion might be completely attained by previously forcing and holding down the floating body so much below its natural floatation level as it would sink if the above weight had been placed upon it. It then being tied down or confined to a forced level, it would have a tendency to ascend to its own floatation level, but cannot on account of being held down: it has, in fact, an upward pressure equal to the force employed in depressing it. It is manifest that the floating body in this state, would resist all attempts to depress it by means of superincumbent weights, until those weights exceeded its upward pressure. To make my meaning clearer, I will suppose that it is required to render a floating body insensible to a weight of ten tons to be placed upon it, or that such weight when placed shall not depress it in the water. To effect this, the floating body must be depressed in the first instance by loading it with ten tons, and at this level in the water it should be chained down to the bottom: the depressing agent, or ten tons, being then removed, the floating body has a tendency to ascend or upward pressure of ten tons, but nevertheless retains its depressed level, being tied down. Under these conditions, therefore, it will bear all weights placed upon it not exceeding ten tons, and resist depression therefrom by virtue of its neutralising upward pressure of ten tons.

The application of this principle to obtaining a uniform water line, irrespective of variation of weight of the floating body in non-tidal and quick waters, must be obvious.

In order to illustrate the adaptation of the above principle to practical purposes, I have prepared a design for a floating railway pier in accordance therewith, and such as would be suitable for the extension of the Hobson's Bay Railway into deep water.

To successfully apply any scientific principle to practical results, it is not only necessary that such be theoretically consistent with the object, but also that suitable materials are attainable, and such a structural character be adopted as the peculiarity of the case may demand.

I accordingly felt the necessity of employing such a material, which, combined with form and constructive arrangement, as would realize my original principle, and also entail enormous strength and durability.

After mature consideration I concluded that a wrought-iron tube of suitable width and depth, formed of boiler-plate, and having a cellular arrangement on its sides and surface, and the whole rivetted in the same fashion as the Britannia Tubular Bridge, would answer all required conditions.

The construction of such a pier is shown in the design accompanying, as also the mode of rendering it insensible, as regards position and steadiness to external forces, arising from violence of the waves, tidal changes, or the passage of railway waggons over its surface. I propose that the tubes shall be constructed in lengths of 100 feet each, closed at the ends, and capable, when placed in position one after the other, of being bolted or rivetted together so strongly as to form, when thus united, one hollow beam of uniform strength.

It should be borne in mind that the plan of pier here described is designed strictly as a means of communication with the shipping, and not as a wharf or landing-place, so that the goods may be discharged over the ship's sides directly into the railway waggons, and drawn off without ever touching the pier itself. This arrangement admits of great economy of material in the construction, for the width of the pier is thereby limited to the dimensions sufficient for a double line of rails, or 25 feet, space being allowed in the middle for persons passing.

As the design in question specially relates to Hobson's Bay, my calculations shall be in reference to its fitness for same, and shall bear upon one length or compartment of 100 feet.

The weight of the tube is nearly a ton per foot forward: therefore 100 feet, or one compartment, would weigh 100 tons, which then would displace 100 tons of water, or 3530 cubic feet when floating therein. The superficial content of same is 2400 square feet, which, divided into the amount displaced, will give the depth of displacement at 1.5 feet nearly, which therefore represents the natural line of draught of the tube. It is evident that all waggons or trains coming upon

the tube subsequent to this, will depress it further, until they have displaced their own weight of water, this being the very result that it is my aim to avoid.

I have estimated the greatest weight that can be placed upon the pier at nearly 94 lbs. per square foot, or 1 ton per foot forward, or for each compartment of 100 feet 100 tons, which thus doubles the weight of the pier, and will of course double the amount of draught, and make it three feet.

As I have before explained, the floating body, or pier, is rendered insensible to depressing agency by forcing it down, in the first instance, so much below its own line of draught, and confining it to that level as to displace such a weight of water as will be equal to the weight it is required to bear. Each compartment, therefore, in this instance is depressed 1.5 feet below its own line of draught, and then held to that level by strong chain cables attached to submarine moorings directly underneath. The load of 100 tons, by means of which it was depressed to this level, being then removed, it will have an upward pressure, without motion, of 100 tons. It is thus in a position to permit of the passage of rolling waggon-trains not exceeding 100 tons weight, over its surface; and therefore no depression in the water, or further displacement, can ensue as long as the upward pressure exists to prevent it.

The above calculation of the sustaining power or upward pressure of 100 tons, has been made with reference only to a uniform level of the water, and truly represents the different relations of weight and upward pressure affecting the tube, as, according to my design, would exist at low water in Hobson's Bay.

But as the tide rises three feet, while the level of the tube is permanent, and as 1.3 feet in depth of displacement gives 100 tons of upward pressure, the increase in the height of the tide of three feet being double the depth, and consequently gives double this displacement, an addition of 200 tons will thereby be added to the former upward pressure, making in all 300 tons at high water. The mean upward pressure upon the tube, therefore, between high and low water, will be 200 tons, which is opposed to counteract the estimated downward pressure or gravity of 100 tons from the waggon transit on the surface.

If I have established by the above figures that it is possible to render a floating pier unaffected as to level by the passage of loaded trains over it, it may yet be objected that a

perturbed state of the adjacent water may communicate a rolling motion to it; but a little attention to the subject will lead to a different conclusion.

When a body rolls in the water, it is necessary that one side should be elevated out of the water as much as the opposite is depressed therein. Hence, should rolling occur in this case, the side depressed should be acted upon by a rolling force sufficient to overcome its least upward pressure of 100 tons; and the side upheaved should be acted upon by a force sufficient to snap it from its moorings below, which should exceed 300 tons, as the chain cables and submarine moorings at the bottom must be at least strong enough to counteract that upward pressure, so as to prevent the tube from rising to its own draught line. From this it is clear that a perturbation of the water must overcome the strength of the materials before affecting the steadiness of position of the pier.

There is yet an important point to be considered. I have shown that each compartment of the tube is subjected to an upward pressure of 300 tons at high water; and as it is tied down to submarine moorings by means of chain cables, in order to preserve it at a permanent level, it is clear that not only the chain cables must be proof against this strain, but that the nature of the moorings must be such as to afford a perfect holdfast. I therefore think it advisable that in order to sustain an actual weight of 300 tons, they should be proof against 500 tons at least. The submarine moorings consist of large troughs made of boiler-plate, properly ribbed, 25 feet long, 17 feet wide, and 10 feet deep, placed immediately under the tube at intervals of 100 feet, or one for each compartment. They are filled with stones, gravel, or sand, and are connected with the tube above by strong chain cables, as shown in the plan: the strength of mooring thus obtained being represented by the weight of the whole in water, and being only 120 tons, is hence insufficient of itself; but when these troughs are connected with the bottom with screw piling, it is manifest that any amount of strength required will be obtained.

It may be thought that a floating pier carried out like this, and terminating without any rigid connection with the bottom of the Bay, as if on an abutment, will not be sufficiently protected, and be subject to lateral displacement by pressure from the sides of ships: with regard to which I would observe, that, irrespective of the means already provided in my

plan by means of submarine moorings, producing upward pressure and consequent steadiness, the immense momentum of such a floating mass, being 1500 feet long, and weighing 1500 tons, alone would protect it from being affected by minor forces. There would be no difficulty, however, in terminating the pier upon an abutment formed of boiler-plate chambers, filled with concrete or gravel, and being thus secured at both extremities, and inflexible laterally, would be perfectly rigid to all exterior forces save those sufficient to snap it from its moorings.

The above observations are intended to suggest the possibility of obtaining an unyielding principle in floating bodies which is so desirable in many instances, such as the crossing of estuaries, where it is impossible to erect rigid structures, owing to depth or badness of bottom; and although the subject is imperfectly considered in this paper, it is hoped that the principle started therein may yet be brought to bear practically, when necessity shall insist upon a departure from plans unsuited to extraordinary circumstances.

ART. V.—*Report II. of* WILLIAM BLANDOWSKI, Esq. *to the Honourable the Surveyor-General, on an Excursion to Frankston, Balcomb's Creek, Mount Martha, Port Phillip Heads, and Cape Shank.*

Camp at Western Port, 31st December, 1854.

ON the 20th November, 1854, I started on an excursion round the Southern coast, towards Cape Paterson; on my route I visited the mouth of the Mordialloc Creek, Frankston, Balcomb's Creek, Mount Martha, and Arthur's Seat, the Heads, Cape Shank, and Western Port.

I. The road runs nearly parallel with the coast, but between Melbourne and Frankston offers nothing worthy of particular observation.

The land is elevated about ten or twenty feet above the level of the sea, and in general is flat and sandy. Groups of very fine honeysuckle trees of an uncommonly large size are abundant near the shore, offering a shady retreat to the great funereal cockatoo (372, *Calyphlorhynchus funereus*) and patches of dense tea-tree scrub also impart a peculiar character to the coast.

The ford at the Mordialloc is difficult and dangerous to

DESIGN for a PROPOSED FLOATING RAILWAY PIER for HOBSONS BAY by Fred.k Acheson C.E.

Scale of Feet 5 10 20 30 40 50

Section shewing Vessel lying alongside

Transverse Section

Railway Waggon

Dotted lines shew the proposed Vertical level of Tube

Cells Cells Cells

High Water

Low Water

Tube of Boiler Plate 25 ft wide and 7 ft deep

Inner Tube

Wrought Iron Trough filled with Stone weighing in Bottom

Wrought Iron Trough filled with Gravel or water 120 tons & secured to the with Screw Piling

Wrought Iron Trough filled with Sand

Bottom

Elevation

Shewing one Compartment 100 feet long

Dotted Line shews the level the Tube would rise to by virtue of its upward pressure of 100 Tons if not held down by the Chains

High Water line in Hobsons Bay

Low Water line in Hobsons Bay

Wrought iron Trough weighing in water 120 tons & secured to the Bottom with Screw piling

Wrought iron Trough weighing in water 120 tons & secured to the Bottom with Screw Piling

Bottom

De Gruchy & Leigh Lith.o Melbourne.

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cross, as the quicksand at the mouth of the stream fixes the horses or dray at the least stoppage, and the animals, unable to obtain footing, refuse service.

About Frankston the coast rises abruptly to a height of two or three hundred feet above the level of the sea, and from that point to Arthur's Seat is well timbered with shea oak and other trees, which afford to the inhabitants of those districts a trade for supplying ships with firewood for Melbourne.

These trees all have an easterly inclination, proving the predominating winds to come from a west-south westerly direction.

The surface soil of this district is situated at some height above the sea, and consists of poor alluvial sand resting on tertiary sandstone.

Mount Martha and Arthur's Seat, the summits of which are elevated only about four hundred feet above the adjacent lands, form, together with Mount Eliza, the commencing points of three series of ranges, all pursuing an easterly direction. They are separated from each other by two large gullies, containing Hunter's and Balcomb's Creeks, and the Survey Flat, and decrease in magnitude eastwards, till at Western Port they are altogether lost.

Jameson's special survey, south of Mount Martha, consists of a low and in some places swampy plain; an excellent clay for the manufacture of bricks is here obtained, which some enterprising Americans have already turned to account, and erected a powerful engine, on a spot contiguous to the shore, to assist in their object.

Along the whole of Capel's Sound the coast is sandy, and the low banks facing the sea are covered with dense masses of tea-tree scrub.

With the "Whole Cliffs," or as they are better known to the population of the neighbouring districts, the "White Cliffs," begins the peninsula forming the Heads, and terminating in Point Nepean.

These cliffs rise to an altitude of about one hundred feet above the level of the sea, and are entirely formed of tertiary limestone and sand hummocks. The latter, which are very steep, are completely covered with a low and poor scrub, their appearance altogether being apt to suggest to the traveller the idea that Nature, so provident elsewhere in Victoria, has almost overlooked this part of the country.

A similar remark applies to the whole of the southern

coast, between the mouth of the Murray and Port Fairy, and to the immense tracts of land comprised under the term of the Mallee Scrub.

But even the desert character of this peninsula is counterbalanced by a circumstance which will tend to raise it to a place of some importance, I allude to the abundance of limestone found there, which is almost entirely absent near the metropolis. Coupled with this is the fact of its being situated in close proximity to the shores of the Bay, which thus renders it immediately available for the supply of Melbourne, and opens an advantageous field for the application of labour.

Approaching Cape Shank a series of wild and picturesque scenery everywhere meets the eye, that has so long rested on the monotonous shores of Port Phillip. Eastward from Point Nepean, and beginning with Cape Shank, the coast rapidly changes its physical character. Dark masses of basaltic rocks, forming wild cliffs, beetle two or three hundred feet above the level of the sea, and bring out in strong contrast the deep indigo blue of the ocean, whose mighty billows, crowded with white and glistening foam, roll in perpetual grandeur on the yellow sands of the beach. Along the tops of these hills the land is undulating, and forms conical hills diversified with steep gullies or basins, the sides of which are profusely timbered with shea oak. The rich basaltic soil near Barker's home station, the magnificent wood with which it is timbered, the numerous springs of excellent water abounding in the gullies, and also the facilities with which communication with Melbourne might be effected by the formation of a road to the Heads, constitute this part of the country a most favourable locality for colonisation by small farmers, and they would, moreover, be enabled to derive profit from various minor sources, such as supplying ships proceeding to sea, from the Heads, with vegetable products, the soil being, in my opinion, exceedingly adapted for the cultivation of fruits.

Between Tuck's and Halm's stations the soil is sandy, though occasionally diversified with patches of rich basaltic soil. This is the principal locality where saplings for telegraph posts are obtained.

Leaving Halm's station towards Dr. Adams', the coast assumes a low and sandy appearance, and consists generally of open plains covered with heath and light forest. The shores are composed of immense quantities of sea-weed,

covered by a light layer of sand, which makes them exceedingly difficult and dangerous to travel over on horseback.

Inland, between Mount Martha and Arthur's Seat, the country consists of low plains covered with heath and fern, and dense thickets of diminutive trees, chiefly stringy bark.

Oysters are obtained near King's station in great abundance, and about twenty or thirty men are already engaged in dredging for them, and obtain a good living by supplying Melbourne and Geelong, as well as the immediate neighbourhood.

I was informed by them that they forward on an average throughout the year three or four hundred oysters per day for each man, and they are sold on the spot to the traders and people in the neighbouring stations at 6d. per dozen.

II.—The country between Frankston and Balcolm's Creek is more or less composed of feruginose sandstone, belonging to the upper tertiary formation, and formed during the period of basaltic eruption. It consists of the following strata, beginning with surface soil, and continuing down to the basalt. I found these strata strikingly exhibited on the shore of the Bay, between Snapper Point and Balcomb's Creek,

No. 1. Alluvial soil of a deep grey colour, sandy and impregnated with vegetable matter. It varies from two to three feet in thickness, and forms a soil on which shea oak, as well as other trees, and especially coast plants, thrive luxuriantly.

No. 2. Shells. Immediately below this soil occur large quantities of marine shells, precisely similar in form to those at present found alive in Port Phillip Bay. Although still partly retaining their original colour, and being neither petrified nor impregnated with gypsum or calcium, they are all more or less broken and reduced into fragments, and are seldom to be obtained in a perfect state. This circumstance I think proves the oceanic action to have been very violent during the first igneous outbursts which raised our present coast. This layer of shells varies from one to two feet in thickness.

No. 3. A layer of sandy white clay, contrasting strongly with the intense red colour of the lower strata. It varies from ten to twelve feet in thickness, and its nature is such as to resist to a surprising degree the abrasing influence of the sun, wind, and rain; a great many cavities, however, are washed out of the stratum, and this imparts to it a rather

picturesque appearance, strongly resembling at a distance, and during sunshine, a miniature representation of the Alps.

No. 4. A red clayey sand, sometimes amber yellow and marbled. This stratum varies from ten to fifteen feet in thickness, but presents no peculiarities worth noticing.

No. 5. A layer of sand of a dark brown or red, or occasionally a pink colour.

This stratum varies from ten to fifteen feet in thickness.

No. 6. A hard sandstone of a dark brown or chocolate colour, occurring in a stratum of from twenty to fifty feet in thickness. The particles of quartz of which it is composed are cemented by oxide of iron. This sandstone in some places entirely changes its character, the cementing material being clay instead of oxide of iron, which imparts to the stratum a totally different appearance.

This latter sandstone, of a grey colour, lies about four or five feet above the level of the sea, and evidently contains fossil vegetable remains. It appears from this fact that this stratum, after forming the surface soil of a former epoch, was submersed, but subsequently again made its appearance above the sea. The fact of it still rising is, I think, proved by the existence of the shells described in No. 2, and the fossil remains subsequently enumerated in No. 7.

At one place I found the stems of trees, about one foot in diameter and from ten to fifteen feet in length, jutting out from the sandstone banks on a level with the sea.

The substance of these remains is identical with lignite, and although not here of very good quality, will, if found in greater quantities, perhaps become valuable as a substitute for coal.

The same formation I am well aware occurs in Flemington, St. Kilda, and Brighton, and I have also personally observed its existence at the Onkaparinga, on the coast of South Australia. At the latter place it exhibits precisely the same appearances as in the locality now under consideration. While speaking on this subject I may also mention that in South Australia no natural indications are found by which to estimate the comparative ages of these strata, since no basalt has been discovered near the spot, and even in the low lying clay strata there are remains of marine shells of kinds, no description of which has yet been published.

No. 7. A tough blue clay with layers of spheroidal masses of clayey limestone, containing multitudes of fossil remains, similar to the sphaerosiderite, imbedded in the clay deposits

of the Polish jura or oolite formation, near the Prussian silesian boundary.

These curious rounded blocks of limestone vary in size from one foot, and even less, to four feet in length, their thickness being from six to twelve inches. They are imbedded in two or three layers, one above the other, and are scattered throughout these strata as well singly as in groups. The settlers have not inappropriately compared them to dampers, by which name they are generally known.

I also found in the same stratum iron pyrites and sulphur of lime or gypsum. The gypsum occurs in spear-formed crystals, about three inches in length, and is in form quite distinct from that found by me at Batman's Hill, near Melbourne.

The fossil remains in the limestone exhibit precisely the same forms as those of the blue clay. The shells in the clay are, however, neither impregnated with calcium nor any other foreign substance, and very easily broken, or rather crumbled into fragments, whereas the shells in the limestone are beautifully petrified. Those palœontological remains consists of mitra, crepidula, murex, conus, voluta, cypracidæ, siliquaria, lunulites, cyrrobranchiata, patellidæ, fungia, pecteri, terebratula, megalodus, cytherea, limopsis, spongia, retepora, thamniscus, tabellum, andonea, cellopora, and nautilii, all in a most perfect state of preservation.

I can only account for the total absence of all indications of cray fish and teeth of fishes amongst these remains by supposing that the prompter volition and motion of these animals preserved them from becoming imbedded in the clay.

Having taken a summary glance over the whole of the strata mentioned in the foregoing pages, I am of opinion that they form the sides of a clay basin belonging to the upper tertiary formation, and coeval with the uppermost strata of the London, the Paris, Vienna, and different Italian clay basins.

This particular spot, near Mount Martha, being at that period a favourable locality for the production of the different species of shell fish above enumerated, will explain its richness in fossil remains, and it is worthy of notice that a little further along the coast, southwards from Arthur's Seat, there is a spot remarkable for the great numbers of oysters and pectens, and abundance of minute shells which strew the beach.

The clay basin before mentioned is interrupted in two

places by the basalt. In one of these places the basalt occurs in horizontal platforms, which could easily be mistaken for stratifications.

These platforms are crossed in a perpendicular direction, by a network of iron ore (*Thoneisentein*), which completely disconnects them from each other. The meshes of this network are about six feet apart, and from six or eight inches in thickness.

The iron ore mentioned in the preceding paragraph is of greater interest than might at first appear. It is formed by a combination of aluminum and iron of good quality, there being more than thirty per cent. of the latter. When fresh broken it is of an ash grey colour, but after being exposed to the action of the atmosphere and the sea, assumes a clear brown colour, resulting no doubt from the oxidation of the iron, and traceable in all the fissures of the rock.

I would account for the origin of the sandstone described in No. 6 by supposing the iron just mentioned to have been partly washed away by the waves of the sea, when from its greater specific gravity, it would immediately seek the bottom, and by oxidising and cementing the sand, so formed the sandstone referred to.

I have reasons for believing this sandstone to have risen very rapidly above the surface of the sea from the following fact.

Between the basalt and sandstone in question occurs a greyish stone, which is in reality nothing else than partly decomposed and metamorphosed basalt or dolerit, although not readily recognised as such. It is in fact a mass of the same species of rock as that cut out from the cite of the Exhibition Building in Latrobe street, and King street, near the Flagstaff, Melbourne, and which many are inclined to take for pipeclay. It was not until my arrival at the locality of which I am now speaking, and until I had an opportunity of there observing a similar mass, that I was enabled to form a correct judgment of the true nature of this peculiar rock. The gravel found above it at the Exhibition site is identical with the stratum described in the latter part of No. 6.

A few chains south-west from this point (between Balcomb's Creek and Snapper Point) lie two small islands or reefs at a short distance from the shore. At low tide they are about one foot above the sea, and are the resort of hundreds of white-bellied shags (613 *Phalacrocorax leucogaster*), and Bass's Straits fern (562, *Thalasseus policercus*)

that retire thither to digest undisturbed their rich and abundant food.

These islands consist of regular pentagonal basaltic columns, the sides and bases of which are cemented by oxide of iron. The regularity of these columns imparts considerable interest to the islets, which is still further enhanced by the large numbers of birds frequenting them.

It was during the period which produced these basaltic columns that the coast of the bay was raised to its present level. In support of the opinion that this was effected very rapidly and at a comparative recent date, I will here adduce following strong reasons:—

First. The shells found on the surface (*vide* No. 2) have scarcely yet lost their original colour. The question here arises how long a time the decomposing power of the atmosphere and of other chemical causes, would occupy to effect the discolouring of these shells? If this were well ascertained the rising of the coast during any portion of time could be approximately estimated.

Secondly. The vast numbers of plants which only thrive in the immediate vicinity of the sea, and are now found on the plains about one hundred feet above the level of the sea, and the fact that brackish water soaking through the superincumbent strata, its saltness increasing as the altitude diminishes.

And, thirdly, the shells found in the lower strata on the beach, which are originally inhabitants of the deep seas only, but are now raised about four or five feet above the level of the Bay.

This hypothesis is further supported by the fact that the limestone at the Heads is arranged in three distinct strata, of which the lower and upper occur in thin horizontal layers, both of equal thickness; while the middle stratum exhibits an abrupt dip eastwards about 40 or 45 degrees.

This cannot be explained in any other way than by supposing the coast, in its gradual formation, to have received a sudden and violent check from some internal cause, which made the stratum sink at certain points. At this period a new horizontal layer was formed on this inclined strata; but by a second convulsion, both being raised, the primary stratum was again disposed horizontally, and the second inclined at the angle at which it at present occurs. Eventually, during a third period, another stratum was laid horizontally on the inclined substratum, and the whole were subsequently

raised bodily from the bed of the ocean, and assumed the appearance which they now present. The last layer constitutes the present surface soil.

The limestone here mentioned constitutes the whole of the South Australian coasts, and as its extent is so considerable, I will endeavour to fix its character, by presenting a detailed description of all the different forms under which I have observed it.

No. 1. A fine grained limestone without any fossil remains; of a light cream colour, with here and there a small hollow or cavity, containing the bones of lizards and birds; not petrified, nor yet completely destroyed.

Guano, of very fair quality, is found in these cavities; and I may here express my belief, on sundry grounds, that it exists in considerable quantities along the southern coasts.

This limestone occurs in blocks, of one or two feet in thickness, and is admirably adapted for the use of lime-burners. I mention this circumstance, as it might be the means of affording subsistence to hundreds of industrious men, a few being already engaged in this branch.

No. 2. A layer of limestone in curious and interesting forms, which have not inappropriately been compared to a forest on a hill side. The trees appear in some places to have had their tops lopped off by a hurricane. The roots and stems are most perfect resemblances; the latter, in many places, being hollow, but nowhere exceeding eighteen inches in diameter; and I would carry the mere comparison much further by asking whether the forest, being buried beneath the sea, and completely impregnated with calcium, could leave any other remains of its previous existence but the bare forms of the trees? The roots and crooked stems of these facsimiles resemble those of Mangrove trees.

They are far too irregular and ramified in their appearance to be taken for stalactites alone.

No. 3. The limestone already mentioned as formed during three different periods, is entirely composed of minute fragments of shells. It splits easily into large sheets, and is used in Melbourne for building purposes.

Cape Shank is formed of basalt, of a very deep colour, containing a large quantity of olivine and anguite. In some places it is impregnated with carbonate of strontium and carbonate of calcium, to so great an extent as to become perfectly amygdaloidal.

The following fact is somewhat remarkable. The basalt

occurs in clusters of irregular columns, varying in height from 40 to 50 feet, and decreasing in thickness from the top to the bottom, till, at a certain point, a little above the sea level, their traces are altogether lost in the stratum forming the basis. It appears to me probable that some terrestrial magnetic agency was the original cause of inducing action in the crystalizing power of the mass, from which these columns were produced.

IV. Of birds and animals, &c., I have little to say, as much experience and careful observation are required to ascertain their habits, modes of living, and other details connected with them. Upon these subjects my remarks are therefore as yet very limited.

During the month of October, nearly all the birds of Victoria lay their eggs; November is the building and moulting season; in December the young broods are hatched, and speedily begin to exercise themselves in short flights.

At this season birds are not very plentiful, except in the scrub, and near water holes; in places sheltered from the intense heat of the sun: being moreover extremely shy, they are with difficulty obtained.

The stubble quail (452, *Coturnix pectoralis*), perhaps forms an exception to the rule mentioned at the head of this section, since it appears to lay its eggs throughout the whole of November and December. These birds spend the greater part of the day in sleeping and basking in the sun, and they are not easily startled till the sportsman has arrived within arms' length of the place where they are sitting, when suddenly taking wing with a loud rustling noise, they so surprise him as often to elude his utmost vigilance.

In the breeding season the crows (269 *Corvus coronoides*) retire from the neighbourhood of the squatters' station into the mountain ranges. In these retreats they live principally on insects, chiefly obtained beneath the dung found about cattle camps.

During December the young magpie (90 *Gymnorhina organicum*) begins to fly, and is first taught by the old ones to utter the sonorous gurgling noise so peculiar to these birds; but which, however, during their first rude essays, is far from being melodious.

The well known lories (384 *Platycercus pennantii*) are, during these months, in beautiful plumage. The young of these birds do not make their appearance until the latter end of December.

The different wood swallows (68 *Artamus sordidus*) (72, *Artamus personatus*), masked wood swallow (73, *Artamus superciliosus*), white eyebrowed wood swallow, associate without distinction of species, in groups of several hundreds, and in the beginning of December exercise their young in flying at a vast altitude.

The ground thrush (254, *Cinclosoma functatum*) moults in December, at a later period than most of the other birds. This bird is remarkable for its quick motion on the ground amongst the thick grass, exhibiting almost the habits of the grallinae. This thrush possesses the smallest wings, in proportion to the size of its body, of any known land bird: thus if the proportion between the wing and the body of any other bird be expressed by 1. 1. 72, or 1. 1. 80., which is a fair average, that of the ground thrush will be represented by the ratio 1. 1. 47.

In December the forests resound with the harsh guttural cry of the common wattle bird (306, *Anthochaera carunculata*), resembling the words "Jacob, Jacob, Jack," the young being about that time taught to imitate it.

The first breeding season having expired, the little stringybark parrakeet (415, *Trichoglossus pusillas*), again renews its affection to the female. It is then easy to approach. The same remark applies also, though in a less degree, to the blue mountain parrot (409, *Trichoglossus swainsonii.*)

During these months the New South Wales oriole (263, *Oriolus viridus*), may be observed flying singly through the woods, uttering its solitary and monotonous note.

The young of the golden eagle (1, *Aquila fucosa*), or eagle hawk of the colonists, have, at this period, arrived at full maturity, and find ample sustenance by preying upon the young broods of birds which, at this season, are so abundant.

The summer birds (99, *Grauculus melanops*) assemble in groups of three or four in the denser parts of the forest, and appear to live in perpetual enmity with every bird around them. They are constantly obliged to defend themselves against the attacks of the magpie, and several species of smaller birds.

The cuckoo is, at this season, very plentiful, its shrill note being heard in every part of the forest. Of these birds I have noticed a great number of different species (338, *Circulus inornatus*, unadorned cuckoo), (340, *Circuulus inoperatus*, brush cuckoo.) I have frequently observed the bronze cuckoo (342, *Chysoccyx lucidus*) being fed by several smaller

birds, of a species of which I have not yet been able to procure.

The young of the laughing jackass (57, *Dacelo gigantea*) become fully matured about the middle of December, and make the woods re-echo with their loud and well-known cries.

The black cockatoo (372, *Calyptorhynchus funereus*) is extremely shy and wary. In November it first exercises its young in flying, and teaches them to be on their guard against their almost constant enemy, man.

The beautiful "budgerr gaw" (405, *Melopsittacus undulatus*) is, at this season, extremely plentiful, the immigration from the warmer climates having just taken place. This bird, which is indeed an ornament to the country, frequents the low lands near the sea, and can be checked in its flight by the utterance of a peculiar cry. They are very easily obtained, as they are not afraid of the approach of the sportsman; and, moreover, by gathering in thick groups, offer an excellent shot. It used to be commonly believed by the colonists that these parrots were to be found in South Australia only, but nothing could be more erroneous.

III. Reptiles.—The slow or blind worm (*Egerna cunninghami*) belonging to the genus, *anguis*, is very closely connected with a species found throughout the whole of South Australia, and known to the settlers of those parts by the more appropriate title of the sleeping lizard. The body and tail are, however, of a more cylindrical form than those of the species referred to. The scales are also more smooth and glossy; those situated on the upper part of the head consist of five plates, each of which is divided from the other by a pair of lateral plates, of which the edges meet in the central and longitudinal line of the head. Six other pair of irregular shapes, and forming various sided polygons, surround the central plates, and protect the head of the animal with an almost impenetrable coat of mail.

The tongue and mouth are of a bright violet blue colour; the former, at its extreme point, is slightly cloven. The teeth, none of which are situated on the palate, are very minute. The jaws are very powerful in proportion to the size of the animal; and as it is commonly believed that they are perfectly harmless, I may here mention a circumstance which occurred to me in South Australia.

Having discovered a slow worm basking in the sun, and feeding on some yellow flowers, I handled the animal at first

gently, and then more roughly, without its making the least attempt to bite me. It constantly, however, thrust out its brilliant tongue to terrify me by its venemous appearance, and upon forcing a stick of about an inch in thickness into its mouth, it bit furiously into it, that I lifted it up by the stick, and retained it in that position several minutes before it released its savage grip. The impression left upon the stick was such as could have been produced only by the exertion of great muscular power. The body of this animal is of a pale yellowish grey colour, and is marked with black irregular stripes, crossing it in a slanting direction. The legs are disproportionately small to the size of the animal, being scarcely powerful enough to enable it to move along the ground; and it is, on this account, an easy prey to the attacks of the dingo, which feeds upon it. The tail also, compared to the size of the body, is remarkably short.

The snake changes its skin in December. The way in which this is really effected, will, I am afraid, without a long course of careful observation, remain but very obscurely known. The skin becomes, I believe, first detached from the flesh in the inner portions of the lips, and turns outward over them without bursting. The animal then pushes its head through the opening thus formed by the dead skin, and by dint of some exertion, eventually casts it off altogether.

V.—Quadrupeds.—Kangaroos (34, *Macropus major*) are extremely plentiful between Frankston and Cape Shank, individuals of an uncommonly large size being sometimes observed.

I am assured by inhabitants of these districts that kangaroos of a white, or very light colour, have occasionally been seen, and even obtained; but I may be allowed to withhold my full credence to these reports, till I have myself received ocular demonstration of their correctness.

These animals are frequently observed about midday asleep on the ground, in large groups, like flocks of sheep; and a horseman can often approach within a very short distance of them without being perceived. The oldest individuals are the most vigilant, and when a group are thus surprised, are the first to take alarm. Rising on his haunches, one of these "old men," as they are termed, listens attentively, to ascertain the direction from which the warning noise proceeded; then selecting that most favourable for their rapid retreat, he makes a few short leaps, and again

listens attentively. If the cause of alarm is repeated, the whole group at once start off, and very speedily disappear in the depths of the forest. Sometimes, however, a few, not heeding the warning, remain on the ground, and so fall victims to the steady aim of the practised bushman. In this way a " mob" of kangaroos is often broken up and dispersed into smaller ones, which rejoin when the danger is past.

The young ones after the warning is given by the older ones, are the first to retreat: those, however, that are dependant on their parents, are received into the pouch of the mother.

I obtained towards the middle of December a fœtus of the kangaroo, still contained in the womb, and suspended to the teat.

The absence of the kangaroo rat (44, *Bettongia jerboa)* and bandicoot *(*73, *Perameles fasciata)* in these districts, is rather remarkable; but it is counterbalanced by swarms of bush rats. These animals burrow in great numbers close together, and patches of ground completely honey-combed by them are everywhere observable. Such spots are, on account of the size and depth of these holes, dangerous to pass over with a horse.

The porcupine *(*21, *Echidna hystrix)* generally makes its appearance from its hole about sunset. It is plentiful along the sand hummocks along the southern coast.

VI. Aborigines.—Of the aborigines of these parts, I am unable to say anything, as I have not yet had an opportunity of meeting with them, except perhaps a few camped at the Mordialloc Creek; some of whom, however, belonged to other parts of the country, being banished from their native tribes. The original natives of the districts bordering on Port Phillip and Western Point are, I may say, extinct.

ART. VI.— *Observations on the Geology and Soil of the Country adjacent to the Upper Murray, and also on the Development of the Productive Capabilities of that Portion of the Territory of Victoria.* By CLEMENT HODGKINSON, Esq., Civil Engineer, Vice-President of the Philosophical Institute.

HAVING recently made a cursory reconnaisance of that portion of the basin of the Murray comprised between the Mitta-Mitta and Campaspe, with the view of supplying an

official report on the operations for the improvement of the navigation of the Murray River, I now beg to submit to the members of the Philosophical Institute a few observations on the geology, soil, and future capabilities of the country traversed.

The land contiguous to that portion of the Murray extending from the junction of the Mitta-Mitta to that of the Ovens, consists of narrow level tracts of recent tertiary formation, comprised between the alluvial river-side flats, and high well-grassed forest hills of crystalline rock, that stretch away westward to a considerable distance below Albury, on both sides of the Murray. The highest of these ranges consist of granite; but on the ranges near the river, the most prevalent formation is mica-schist, alternating with the following rocks,—namely, hard quartzose slate—granitiform gneiss—quartz veins thickly studded with crystals of black tourmaline, or else displaying large projecting scales of yellow or white mica—compact quartz rock.

On a range of this formation near Albury, crystals of pink felspar occur in large masses, with scales of mica of argentine lustre in the interstices.

Above the junction of the Ovens, the recent tertiary formation to which I have alluded, displays soil of great fertility —abounding in the alkalis derived from the decomposition of feltspathic rocks, and frequently maintaining a very homogenous appearance to a depth of several feet below the surface. It is in general highly ochraceous, and is, above the confluence of the Ovens and Murray, more inclined to be argillaceous than arenaceous. In this soil lumps or nodules of concretionary limestone are frequently encountered in great abundance at various depths, and are probably derived from the action of rain water on the fossils originally contained in the soil.

The other beds in this recent tertiary formation are a fine grained friable sandstone—a coarse ferruginous quartzose sandstone—a quartzose conglomerate of similar nature—and pipeclay. These tertiary beds are well displayed in section on the escarped banks which characterise those portions of the river bergs on which the stream impinges. Small springs are frequently seen at points on these escarped banks along the visible line of junction of the upper pervious beds with the pipeclay.

From the junction of the Ovens to that of the Goulburn, and thence to that of the Campaspe, the red tertiary soil contiguous to the Murray is more arenaceous than near Albury

and Belvoir, but yet evidently contains elements of fertility highly favourable for the production of wheat and the cultivation of the vine. The indigenous vegetation thereon consists of well-grassed forest of varieties of box (*Eucalptus Corymbosa*), interspersed with clusters of the cypress pine (*Callitris Pyramidalis*), Casuarina torulosa, Banksia, Exocarpus cupressiformis, and several species of Acacia.

Between the Murray and the Broken Creek (which is a long but ill-defined anabranch connecting the Broken River with the reed beds of the Murray near Moira), there is an extensive tract of level, badly-drained forest country, diversified however, by many open grassy plains, some of which occasionally occupy an area of several thousands of acres, and are of very pleasing aspect,—their irregular but well-defined margins being fringed by the graceful *Callitris Pyramidalis* and *Casuarina Paludosa*,—whilst their lawnlike surfaces are not unfrequently enlivened by groups of emus or bustards.

A dense underwood pervades much of the forest in this part of the Murray district in Victoria; and I also noticed that a vast extent of forest country on the New South Wales side of the Murray was similarly scrubby. This growth of underwood has been very rapid of late years, in consequence of the comparative cessation of the bush fires, which formerly kept it down. It threatens serious deterioration of the grazing capabilities of forest land adjacent to the Murray.

This level tract of country between the Murray and Broken Creek, seemed to me to display indices of comparatively modern fluviatile drifts. On the surface of an open plain near that anabranch, and at an elevation considerably higher than that of the highest floodmark near this plain, I noticed a great variety of waterworn fragments of quartz, quartzose schist, slate, &c., all of which have been brought down from ranges very far distant from the plain where seen. The Murray, subsequently to the rise of the submarine bed of the large estuary corresponding to the tertiary deposits of the upper portion of the basin of that river, must have commenced to cut and gradually deepen a channel through them; and that this deepening process has been until recently in operation, is very probable, on account of signs of former river floods comparatively very much higher than any known to have occurred since the occupation of the country of the Murray by Europeans. But as the average elevation of the surface of the Murray near the junction of the Goulburn is about 290 feet above the level of the sea, and its elevation at

Albury (roughly estimated from the apparent average velocity of the stream, and length of course from the Goulburn junction to Albury), at least 100 feet higher,—whilst the surface levels of the tertiary formation along the portion of the Murray now in question, are relatively but very few feet above those of the corresponding levels of the greatest river floods, the denudation caused by the Murray since the upheaval of the marine deposits is not great. Whether this upheaval has occurred at some modern period, or is still slowly and imperceptibly going on, is a question which a more extended inquiry must solve.

The ranges of hills in the vicinity of the Broken River, consist principally of granite. On Futter's Range, which forms the watershed between the Ovens River and Broken River, I noticed at one point a fine very close-grained flesh-coloured granite, probably appertaining to a vein referable to a more recent period than that of the protrusion of the ordinary coarse-grained granite of that range.

On ascending the Goulburn, the tertiary formation is found to predominate as far as Murchison. Quartzose schists prevail northern and eastward of Murchison; and on approaching Seymour, basalt is seen adjacent to slaty flagstone, which is altered on contact with the basalt into a hard flinty rock. This slaty flagstone would afford tolerable building stone with good bedding, and also slabs for paving.

The surface of the country near the confluence of the Murray and Goulburn, consists of very extensive treeless grassy plains. South of these wide plains scrubby box forest prevails over a large part of country, but its monotonous aspect is frequently broken by small isolated plains remarkably well grassed. Above Murchison the surface becomes undulating, and the soil poor and shallow, unless in immediate proximity to the Goulburn. The face of the country, however, improves considerably on approaching Seymour, after passing the Deegay Chain of Ponds.

The bed of the Goulburn, from its confluence with the Murray up to the Murchison, is narrow and deep; its banks display similar beds of sandstone and clays to those already described in connexion with the escarped bergs of the Murray. Near the junction of the Deegay Chain of Ponds, the river bed is wider, and ledges of soft schist and sandstone often appear therein. Shoals of shingle and quartzose gravel occur near Seymour.

Travelling eastward from Murchison, I passed over the

ranges of quartzose schist which constitute part of the Goulburn gold field. These ranges, which are covered with rather scrubby box forest, maintain the same geological character for many miles northwards of the existing diggings. On emerging from the forest, the surface of the country in the vicinity of the Corinella Creek is diversified by some very extensive open plains, generally well grassed, and intersected by narrow strips of box forest. The Corinella Creek terminates in a fine lake; and a few miles further north, I passed two other smaller lakes (one fresh, and the other salt), in the vicinity of which, and north-west thereof, are some beautiful open downs, covered with oat grass, and displaying on their surfaces that remarkable resemblance to ridges of ploughed land which has been noticed on rolling downs in some other parts of Australia. The view from these open uplands was very pleasing. East and south of the extensive grassy plains, the outline of the box forest, rendered dimly blue by distance, was backed by the apparently isolated summits of far distant mountains, whose connecting chains of hills were below the wooded horizon. To the south-west towered Mount Camel, from whence extended in a northerly direction a graceful undulating granitic range, whose grassy declivities were so diversified by clumps of woodland, isolated trees, and untimbered lawnlike surfaces, as to present to the eye a most parklike aspect. In the front ground the silvery expanse of the nearest lake was thronged by large flocks of swans, pelicans, rajahs, and other aquatic birds; whilst through the intervening belts of trees the waters of Lake Cooper were occasionally seen glittering in the distance.

I noticed brown hematite in considerable quantity on the surfaces of some of these downs; which form of iron ore I had previously seen on the right bank of the Murray within the territory of New South Wales. Quartzose schist crops out on some of these downs, but is accompanied by better soil than is ordinarily met with in juxta-position with that rock.

After crossing the dividing range of forest hills between the Corinella Creek and the Campaspe, the recent tertiary formation is re-entered, and it then extends without interruption along the Campaspe to the junction of that river with the Murray. From the township of Rochester to that of Echucha, the Campaspe meanders through a series of very level open plains, which must obviously be very wet and boggy in many places during the winter months, owing to the want of natural drainage.

I found near the junction of the Campaspe with the Murray some fossilized impressions of shells very closely resembling the *Unio*, or fresh-water muscel, now existing in the Murray. Some of these fossils are comprised in the collection of geological specimens submitted to this meeting with this paper.

The alluvial lands, liable to flood, comprised within the bergs or outer banks of the Murray, are intersected by numerous tortuous lagoons, occupying old channels of the new stream. The soil of these alluvial lands consists of sands and clays, rather sparingly intermixed with vegetable matter. These lands are clothed with coarse grass, and heavily wooded with *eucalyptus globulus*;—large trees of any other kind being only very rarely seen growing below the level of the highest flood line. The alluvial flats of the Ovens up to Wangaratta, and the Goulburn up to Seymour, are also of similar nature.

The soil of the alluvial lands of the Murray River and its tributaries, does not therefore display the exuberant richness characteristic of the alluvial brush lands of the rivers which disembogue into the Pacific, or the eastern coast of Australia. In my opinion, this difference is due to the very rank and luxuriant vegetation of these brush lands, in which numerous plants abound, whose nature is such as to cause them to derive from the atmosphere a very much greater proportionate quantity of carbon than the vegetation of the flooded lands of the Murray districts; therefore such plants by their decomposition tend to increase the richness of the soil from whence they originally sprung, or else to augment the depth of the vegetable deposit. A large proportion of the agricultural produce of New South Wales is raised on farms established on cleared brush land liable to occasional floods. Maize and tobacco grow peculiarly well on land of this description; but I believe these exhausting products could not, for the reasons I have just stated, be satisfactorily cultivated on the alluvial lands of the Murray.

Much of the red soil of the recent tertiary marine deposits of the Murray basin would not only be well adapted for the growth of wheat, but would, from the nature of its constituents, depth, and slight amount of labour required to trench it, render the cultivation of vineyards on a large scale thereon, and the manufacture of wine, a most safe, certain, and remunerative mode of employing capital in this colony: for in no part of Australia—and, I may add, in no part of Europe visited by me—have I ever seen such heavy crops of grapes

in proportion to the bearing wood, as I have noticed in many gardens on both banks of the Murray, as well as at the Broken River and Goulburn. At Tallagaroopna station on the latter river, the produce this year from a few perches of trellised vines was enormous, so that cartloads of the grapes were sent off to the Ovens gold fields from that station.

In my humble opinion, the cost, at present value of labour, &c., of establishing and maintaining a vineyard of 100 acres, selected in a favourable situation in the Murray districts, would be as follows:—

	£
Land—100 acres	100
Buildings and fencing	500
Horses, dray, and implements . . .	400
Clearing and trenching	3000
Vine Cuttings and props . . .	300
*Expenses attendant on 1st year's cultivation .	1700
„ „ 2nd „ .	1700
„ „ 3rd „ .	1700
„ „ 4th „ .	1700
„ „ 5th „ .	1700
	£12,800

As the small quantity of wine made at the end of the 4th year would fully cover the interest (calculated at the ordinary rate) on the capital expended without return during the first four years, and as the vineyard would be in full bearing at the end of the fifth year, the cost of establishing and bringing into full bearing a vineyard of 100 acres, would be £12,800.

The annual expenses of the vintage would, after the 4th year, be about £1000 for the hundred acres of vines; and as the annual expenses of the vine cultivation have been assumed to be £1700, the total annual expenditure for a vineyard of 100 acres in full bearing would be £2700. If now the annual production of wine be at the rate, per acre, of 400 gallons, worth 4s. per gallon, the annual yield from 100 acres would be worth £8000—leaving, therefore, for profit (according to the foregoing assumptions) £5300, which sum would be equivalent to about 41 per cent. on the capital sunk during the first five years.

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* In France about twenty men would be employed on one hundred acres of vines.

I may here incidentally remark, that a vineyard will remain in full bearing for very many years: in some of the best vineyards in France, at Vongeot, Migraine, and Epernay, the vines are 500 years old; for in the provinces of Burgundy and Champagne old vines are never uprooted, but drawn down to the ground and covered with earth every few years. In those parts of France, however, where the *quantity* of wine produceable from a given extent of vineyard is considered paramount to *quality*, vines are in general replanted every forty years.

With reference to the preceding estimate, I beg to observe, that on vineyards planted at favourable sites near the Murray, 400 gallons of wine, per acre, would be, in my opinion, a fair assumption for the average annual rate of production from an acre of vines in full bearing, when it is considered that in New South Wales 500 gallons per acre is frequently obtained from well-established vineyards, when no brandy is made. The production of an acre of vines near Albury, belonging to a German settler, has this year been five tons of grapes; which quantity would, if submitted to the wine-press, have yielded about 700 gallons of wine. In Spanish vineyards, 600 hundred gallons, per English acre, are considered a fair ordinary rate of production. Mr. Busby, in his small treatise on the vine, states that the vintages of France average only 247 gallons per English acre. This rate is, however, below the average rate of production of those central and western portions of France which have been visited by me, and I am inclined to believe that Mr. Busby's estimate must have included, without due allowance, those very extensive tracts of land in the south of France where the rows of vines stand at wide distances apart, and the intermediate spaces are devoted to the growth of wheat, barley, buckwheat, &c. The greater portion of French vineyards also occupy poor soils, often unfit for ordinary agricultural purposes; and even the celebrated vineyards of Ay and Epernay are on soil not only very barren, but also so shallow that the subjacent chalk is frequently encountered by the spade at less than one spit deep. I think, therefore, that the average rate of production of vines planted in suitable localities in Victoria, will be considerably higher than in France.

Having had no practice *in vine culture with reference to wine making*, I feel that I am guilty of much presumption in submitting the foregoing imperfect remarks on the vine to the Philosophical Institute, and I am only induced to do so in the hope

that they may elicit from some of my fellow members of the Institute sound practical information relative to this most important object of culture in Victoria.

The most available lands for cultivation in the Murray River districts would be those portions of the recent tertiary formation contiguous to the Murray, and comprised between the Mitta-Mitta and the Ovens: for near the hills copious rains often occur, when the wide level portions of the basin of the Murray are unvisited by a single shower, and many productions are consequently influenced by this difference of climate. For instance, potatoes, which thrive well near Albury, do not grow satisfactorily at the stations near the confluence of the Murray and Goulburn. Some leguminous plants grow, however, luxuriantly in the level country, as shown in the following statement of the weights of some melons and cabbages grown near Echuca.

Melon (Rock Cantaloupe) . . .	15 lbs.
Melon (preserving variety of *cucumis citrullus*) . . .	28 lbs.
Cabbage (mean weight of some of the largest specimens) . . .	17 lbs.

Whilst, therefore, I am of opinion that the fertile land contiguous to the Murray, above the confluence of the Ovens, would, from its superior climate and proximity to gold fields, be highly available for the location of ordinary farmers and cultivators of vineyards, and that the country around the proposed railway terminus, near the confluence of the Murray and Campaspe, would also be well adapted for the settlement of an agricultural population,—I think that the major portion of the level country adjacent to the Murray, below the Ovens, could not at present be profitably cultivated. For this country, at a distance of a few miles back from the river margin, becomes excessively wet and boggy in winter, and is without water in summer, so that, although an excellent fattening country for stock, it is utterly unsuited for small farms. Should, however, at some future period in the history of Victoria, a very greatly augmented population in the interior, cause the cultivation of the soil on the banks of the Murray to become a paramount branch of colonial industrial pursuits, much of the land bordering on the bergs of the Lower Murray, might be made, with the aid of irrigation, to yield certain and abundant crops of ordinary cereals and leguminous plants, and also to display flourishing vineyards, orange orchards, mulberry plantations, and olive groves.

In reference to irrigation, I have already remarked that the lands available for cultivation along the bergs of the Murray are of very moderate and uniform elevation above the river—in fact, only a few feet in height above the levels of the highest floods; so that I think if ever a numerous series of contiguous farms should be established along any part of the Murray, the water required for their irrigation could be economically supplied to each farm from a flat-bottomed boat, provided with steam-pumping engines, and flexible hose of adequate power and dimensions, to respectively deliver to the farms, from the nearest relative points in the stream, the water required by each farmer for distribution over the cultivated lands along the bergs.

Assuming, by way of example, that irrigation has to be applied in the mode just indicated, to 50 acres of land, elevated 40 feet above the nearest part of the Murray, and about half a mile distant therefrom, then a pumping-engine working in the boat with the power of 20 horses only, would, in three hours, deliver at the required height of 40 feet a quantity of water equal in amount to that which would have resulted from a rainfall of rather more than one-quarter of an inch over the fifty acres of land; or, in other words, a quantity of water tantamount to that derivable from a very copious soaking shower.

The absence of water during the summer months in the back country, causes much fine pasture land to be understocked, and even occasions the temporary abandonment during part of the year of many out stations. In some cases the effects of this deficient supply of water might be considerably mitigated by deepening some of the existing hollows, and rendering their bottoms and sides impervious to water. As clay is attainable in the tertiary formation of the Murray basin, and lime is also procurable in many places, artificial waterholes could be often made watertight at moderate cost, by lining their bottoms and sides with well worked clay, at least one foot thick, and covering the clay with a coating of quicklime one inch thick; over which must then be laid rough pitching, or merely a layer of rough shingle. In beds of ponds thus constructed in Great Britain, the lime has been found to exercise important influence on the clay, preventing its perforation by insects, &c. Mr. Brough Smyth's experiments on evaporation having shown that my original estimate, made in 1854, of 5 feet, is likely to be a tolerably fair average rate for the annual evaporation from pond water

near Melbourne, I believe that in the hotter climate of the Murray the rate would be nearly 6 feet: it would therefore be very important that the conservation of water collected in artificial ponds constructed in the Murray districts, should be promoted when possible, by forming such ponds, of a narrow elongated form, so as to admit of the ponds being partially covered in by charred sleepers of rough timber, surmounted by cross layers of brushwood fascines, and a top coating of earth.

The full development of the productive capabilities of the districts adjacent to the Murray, will mainly depend upon the establishment of railway communication between Melbourne, the Northern Gold Fields, and that river. For whenever the Murray shall be connected with Sandhurst and Melbourne by the proposed railway, a populous agricultural community would soon become located around the proposed terminus at Echuca, and that place would rapidly become one of the most important inland towns of Australia; as it would not only be the entrepôt for the supply of an extensive portion of the interior pastoral country, but also the place of rendezvous, prior to transmission to the markets of Victoria, of an immense amount of stock.

Having in my Official Report described the means hitherto adopted to remove impediments to the navigation of the Murray, and the extent to which it might be advantageous for this colony to co-operate in carrying out further improvements in reference to the navigation of that river, any remarks on that subject would be out of place in this paper. The shoals and ledges of rock in the Murray consist of quartzose shingly gravel, soft shale, sandstone, and highly ferruginous quartzose conglomerate. I was able, in the middle of March of the present year, to cross the Murray on horseback at several places; the lowest thus forded was about 106 miles by water below Albury, or a mile or two above the junction of the Ovens. Captain Cadell informed me that these shoals do not impede the navigation of the Murray by vessels of the light draught employed by the Murray River Navigation Company. The snags, however, constitute formidable impediments to navigation when the river is low, and much energy and determination must have been displayed by Captain Cadell when he accomplished his first ascent of the Murray in the *Lady Augusta* steamer, at a period when the waters of the Murray were but little higher than the ordinary summer levels.

Whilst making this excursion through part of the basin of the Murray, I guaged the discharges of that river and several of its tributaries; but the occurrence of a slight general fall in all these streams during the few days that elapsed between the first and last of these measurements, precludes the results of such direct measurements from being made use of for instituting comparison of the general discharges of the streams.

By applying, however, some slight corrections for the estimated effects of the fall just alluded to, I have made an approximate estimate of the relative discharges of the streams in question, on March 8, 1856; on which day the discharge of the Murray at Albury was 660.400 gallons per minute. Representing this discharge by unity, the following table shows the relative discharges of the other streams guaged.

Discharge of Murray at Albury on March 8, 1856	1.000
Ditto Goulburn at Seymour, corrected to same date	0.370
Ditto Ovens at Wangaratta ditto .	0.100
Ditto Campaspe at Rochester ditto .	0.007
Ditto Broken River at Benalla ditto .	0.003

It would hence appear, on consulting the general map of Victoria, that, in proportion to the areas of drainage above the points where these streams were guaged, the summer discharge of the Goulburn is the highest, and that of the Campaspe the lowest. The large summer flow of the Goulburn is attributable to the permanent and unusually copious springs which arise in the lofty densely wooded mountains which separate the tributaries of the Goulburn from the sources of the Yarra Yarra.

In the level parts of the Murray districts, the principal dray tracks traverse alternately portions of sound ground, of tolerable lengths, and shorter intervening portions of soft boggy ground. Consequently, during the wet months of the year, drays have to be loaded excessively light in proportion to the powers of draught of the teams on the sound ground, in order that they might be enabled to get through the boggy flats. Yet, if on these limited portions of bad ground, short lengths of earthen roadway were formed, and planked ways laid down thereon, these boggy flats would, in lieu of straining the draught animals, become a relief to them, as a horse can actually draw on a level planked way *a load two and a*

half times the maximum load he could draw on a level macadamized roadway.

In constructing in this colony a planked way across one of the swampy flats just alluded to, deep roadside drains would first have to be cut, and the earth resulting therefrom thrown up to form the proposed earthen roadway; taking care to construct culverts in the requisite positions, and cut drains from mouths of culverts, as far as necessary, towards the outfall. Longitudinal sleepers, obtained from any sound variety of *eucalyptus*, and each about 16 feet long, 12 inches wide, and 4 inches thick, might then be laid in two parallel rows, about 3½ feet apart in the clear, in trenches cut to receive them in the earthen roadway. These sleepers would of course have to be laid so that the scarf joint between two sleepers on one side should be opposite to the middle of a sleeper on the other side. Seasoned gum planks, each 8 feet long and 3 inches thick, might then be fastened to the sleepers by 6 inch spikes; taking care to ram the earth well under each plank as it is laid, so as to afford a continuous bearing for the planking. The earthen roadway being then brought up flush with the outer edges of the planking, and a layer of sand about one inch thick spread over all, the planked way would be ready for traffic. In a road thus formed, if two vehicles meet on the planked way, one of them could easily turn off on to the earthen roadway, and regain the planked way after the vehicles had passed each other. The cost of such a planked way, constructed as described, and including the formation and drainage of the earthen roadway, would not exceed, if near well timbered crown lands, the rate of £2000 per mile; and the annual cost of its maintenance would not, in my opinion, be more for the first seven years than one per cent. of the original cost.

In reference to the construction of short lengths of planked way over bad ground in the Murray districts, the *eucalyptus globulus* of the extensive alluvial flats of the Murray and its tributaries, would yield good plank for such a purpose. The sub-varieties of *eucalyptus corymbosa* are, in the level portions of the Murray district, unsound at heart if of large dimensions; and the plank obtainable therefrom would be somewhat inferior to that derivable from the red or blue gum, *eucalyptus* timber, and equally liable to longitudinal contraction. One of these sub-varieties demands, however, special notice, owing to the apparent want of durability of its timber. It is called "Apple Tree" by the settlers on the

Murray, although totally different from *angophora lanceolata*, or the Apple Tree of New South Wales.

ART. VII.—MR. W. BLANDOWSKI's *Report, No. III. to the Surveyor-General, of an Excursion from King's Station to Bass River, Phillip and French Islands.*

Camp on Phillip Island, Western Port,
January 29th, 1855.

SIR,

IN my route along the southern coast, I have visited the following localities: namely, the whole coast of Western Port to Cape Paterson, Phillip, French, and Sandstone Islands.

The land from Dr. Adam's station toward Lisle's, consists for the most part of scrubby and swampy plains, but if drained would be admirably adapted for agricultural purposes. At present, however, it is dry only during the hot months of January and February. Between Lisle's station and the inlets, the land is swampy, and luxuriantly covered with excellent grass, well adapted for fattening cattle.

The inlets are in a very bad state for travelling, the banks being extremely boggy.

The ferryman stationed there does little or nothing towards any improvements, and the boats are in so leaky a state as to become half full before reaching the opposite shore. It would be only doing justice to the travelling population of these parts, and also a great boon to those who intend investing their labour at the coal mines of Cape Paterson, to make some improvement in the means of transit across these inlets. Moreover, as many people lose their way in this short distance, (being scarcely three miles,) and several persons are even supposed to have perished in the scrub and swamps, it is imperative that a track be marked out to prevent such calamities in future. The same remark applies also to the whole roads between Lisle's station and Bass River. It was between these two places that Dr. Mueller missed his way in the beginning of last year, and was exposed to much privation; and Mr. Black, a settler of long standing in these parts, also lost himself in the same locality, being reduced to such extreme distress as to be under the necessity of sacrificing his horse to maintain his own existence. For the formation

of a distinguishable track, only a few marked trees at intervals in the forest, and about a dozen poles with straw heads erected on the plain, would be requisite, as this would amply suffice to guide a traveller unacquainted with these districts.

Expenses could be avoided by simply requiring the inhabitants of these parts to cause a track such as this to be formed.

Between Lisle's and Cuthbert's stations the country consists of magnificent pasture grounds, the horse having to walk through thick kangaroo grass, reaching up to the girths.

I observed between these two places a forest of young gum saplings excellently adapted for building purposes, and for telegraph posts, &c.; and as a new source of industry, favoured by the facility of approach by sea, is deserving of the consideration of the Melbourne population. Straight saplings of any size up to 100 feet, can be plentifully obtained; and I may say, that I have never, during my travels, happened to meet with so fine a forest of these young trees.

On Settlement Point the land is good for agricultural purposes, but the scarcity of water acts as a drawback to the advancement of this locality.

The mouth of the Bass River is well adapted for the formation and future advancement of a settlement; but the banks are at present very thinly wooded. Abundance of fresh water, and the fact that vessels of upwards of 150 tons burthen are frequently anchored at the mouth of the river, are recommendations much stronger than those which induced the formation of a township at Settlement Point; and I may here add, that the occupation of obtaining salt by evaporation is at this locality already extensively carried on, offering to small capitalists a very profitable investment. If the coal fields near Cape Paterson were proved to be workable, the Bass River would at once become the central point of a great mining district, and particularly if connected by a good road with the former locality.

Phillip Island, owing to its position, and to its having an excellent soil and abundance of good water, has also the advantage of being surrounded by a magnificent harbour (any portion of which can be traversed in the numerous channels, about five fathoms in depth, which intersect the mud banks). It is of considerable extent, covering an area of about sixty square miles; and it appears to me that this island possesses all the capabilities for becoming a most thriving part of this country.

The sandy soil between Balcombe's, Calin's, Baxter's, and Mrs. King's stations, and Mordialloc, at once drew my attention to the subject of the coal formation. This soil, which is of great extent, is covered with heath and low fern, and its nature appears to be a somewhat unusual occurrence throughout Victoria.

The compact masses of slate of a dirty greyish brown colour found near King's station, form an excellent material for building purposes, and demand a more careful examination for fossil remains; but as such an investigation would not be in strict accordance with my present mission, I did not feel myself justified in applying labour and time for so speculative an object.

Two circumstances attracted my special observation:—

1st. Springs of excellent water are abundant throughout the whole of this district; and,

2ndly. I could not detect any shells or fragments of such, imbedded in the soil.

The first fact proves that clay or slate, and not basalt, must form the basis of this soil: the second demonstrates that the sand arises from the decomposition of sandstone, and is not the result of any marine deposit, for in the former case brackish water or marine shells would be easily detected when looked for, and seashore plants would still be found flourishing on the rich soil.

The large deposits of bluish clay in the extensive plains near the Great Swamp, as also the sandy soil, and petrified wood scattered on the surface between Lisle's and Cuthbert's stations: the thin layers of fossil vegetable matters imbedded in the same slate as that occurring at King's station, as well as the recurrence of fossil wood at French Island precisely similar to that just mentioned,—all lead inevitably to the opinion that the micaceous slaty sandstone which surrounds Sandstone Island in so many circular layers, belongs to the coal formation. And, my belief in this is still further strengthened by the fact, that I have found on the north side of Phillip Island positive evidence of the coal formation, the strata being about 400 and 500 feet in thickness, and about three-quarters of a mile in breadth. How far they extend inland, I cannot with any degree of probability assume, as they are covered with alluvial sand, and I have not labour at my command to enter into an investigation relative to their extension. Nevertheless, at a hasty glance, I should imagine that these strata compose the upper part of the coal forma-

tion of French Island, and probably stand in some submarine connection with it.

The coal formation of this locality (Phillip Island) consists of cliffs of coarse sandstone, precisely similar to that which I have observed in different coal districts on the continent of Europe, and is about 100 or 120 feet in thickness. In the centre of this sandstone, three thin layers of slate first drew my attention to the probability of its belonging to the coal formation, and I accordingly at once entered upon a search for fossil plants, in which object I have succeeded to my entire satisfaction. Subsequently, being led to examine the small inlet or arm of the sea where I observed these cliffs, I could feel under water, at low tide, by means of a pick, the slate forming the entire bottom; but owing to much mud and seaweed having collected above it, I could not ascertain whether any coal deposits actually existed on this spot. At one place only in this inlet are the slate strata visible; and they here appear dispersed in the most jumbled and promiscuous order, a number of slips and falls disturbing the regularity of the layers, which nevertheless still present a smooth surface, forming the bed of the inlet. The fact that the basalt occurs in the neighbourhood of the coal formation of this locality, in no way militates against the existence of the latter, as I am able to allude to many places where it not only overlaps, but actually breaks its course through the coal strata, without much injury to the coal. (On this subject, see Sir R. I. Murchison's Siluria, chap. xi., page 273; also his Silurian System, page 113.)

This formation, which runs east and west, dips southward towards the granite of Cape Wollomai, and the basalt of the south coast of the island. The apparent paradox can be explained only by an investigation requiring a much greater amount of time and labour than I can justifiably apply for the purpose.

On the point referred to at Phillip Island, the coal formation is exposed to view, and to minute examination, to a thickness of more than 400 feet. It requires a practical mining surveyor to ascertain the best spot (towards the south) where a boring is likely to be successful, in order to ascertain the character of the strata above that mentioned at the inlet, the depth of strata to which our knowledge would then extend, being limited by the dip at which it is inclined.

A second boring on Sandy Island would give the inter-

mediate strata between the lower ones of French Island, and those observed by me at the place before mentioned.

This latter boring, I am inclined to think, would be successful in obtaining coal; but as the uppermost strata of the formation at that point are submerged beneath the waters of Western Port on the one side, and the inlet on the other, and thus separated from those islands, it is questionable whether, in the event of such discovery, it could be worked remuneratively at the present rates of labour, as the difficulties to be overcome in regaining the surface from the sea, are such as could only be met by the appliances brought to bear in Europe.

However, were it even only for the purpose of scientific information, and for the sake of gaining experience in further researches for coal fields, it is of importance that two such borings should be undertaken, as they would reveal to the geologist all the intermediate strata to the depth of upwards of three miles—an opportunity which certainly ought not to be neglected.

On consideration of the facts enumerated in this report, I am decidedly of opinion that some search should be instituted, and boring commenced, for the discovery of workable coal seams at those several spots, namely, on Phillip Island, French Island, and Mrs. King's station.

The district named would form a much more preferable harbour for shipping than that of Cape Paterson mines, and a large revenue by the sale of lands might be expected to accrue from so valuable and important a discovery, especially as the soil, though of a sandy appearance, is in general of excellent quality for agricultural purposes.

The granite of Cape Wollomai is quite peculiar to that locality, and forms picturesque pyramidal peaks, on and around the tops of which are seen numbers of large sea hawks (ospreys) and gulls. This fine-grained granite is characteristic, on account of the intense green colour of the mica, and the livid flesh colour of the felspar. This may be the orgin of the local reports concerning copper, which is believed to exist in this district. Between this granite a layer of quartz rock winds its course along the foot of the hill. At the same time is also observed a highly interesting fact, namely, the junction of the volcanic and plutonic rocks, where the basalt comes into contact with the granite.

The basalt formation is most extensively and magnificently represented on Phillip Island, every variety occurring in

great abundance. No locality in Victoria offers to the student a wider field for examination, in the study of the basalt formation, than this island. I will here briefly point out the several characteristics to be observed there:—

1. Dense black basalt.
2. Dense basalt occurs in platforms and columns.
3. Porous basalt, becoming perfectly amygdaloidal calspar, amalcine, arragonite, mesotype, and zeolites, embedded in it in large cavities. Point Grant.
4. Basaltic caverns of considerable extent may also be observed.
5. Intensive light chocolate coloured basalt, of a soft nature, in some places assuming the character of fuller's earth, closely allied to the basalt conglomerate.
6. Basalt conglomerate, of black colour, the pieces never exceeding the size of a man's hand.
7. Conglomerate of chocolate colour, of a similar nature with Nos. 5 and 6.
8. Columnar basalt, very regular pentagonal columns: the interior consists of dolerite.
9. Dolerite or greenstone.
10. Decomposed dolerite, of a greenish colour, with light spots, appears like clay.
11. Dolerite, blending with basalt, rapidly, yet so gradually, that no boundary is distinguishable (*vide* No. 8).
12. Decomposed basalt, chocolate colour, forming the rich alluvial soil.
13. Veins of a slaty-clay nature, of considerable size, and yellow ochreous colour, creeping through the basalt columns for a considerable distance (about a quarter of a mile.)
14. Concave basins in basalt conglomerate (*vide* No. 7), one chain in diameter, deep brown or red colour.

The little island situated between Settlement Point and French Island, consists entirely of basalt. Its surface is only about three or four feet above the level of the sea. It is the breeding place of multitudes of sea birds.

The total absence in Phillip Island of slate of older formation than the carboniferous strata, is rather remarkable, as at the distance of a few miles the plutonic and neptunic rocks appear to be separated by the volcanic agency, and no other neptunic rocks are visible, besides the slate and sandstone of the carboniferous era.

On the southern coast of the island, I found washed up by

the sea, boulders of flint, of precisely the same nature as that occurring in the chalk formations of Europe.

On the south-west point I likewise obtained some very beautiful analcime crystals. From analysis I find the composition of these crystals to be—Silica, 55; alumina, 23; soda, 14; water, 8.

Along with this new Victorian mineral I also found mesotype: its constituent parts are—Silica, 49; alumina, 27; soda, 17; water, 9; and iron oxide, 1.

Between Phillip and Churchhill Islands occurs a quantity of chalcedony, washed up on the beach by the sea. This beautiful material might easily be made available for ornamental purposes.

On the eastern side of French Island, two quarries of excellent flagstones for pavements could with little difficulty be opened, since, as elsewhere mentioned, numerous vessels constantly run between Melbourne and that locality. A profitable investment for labour is here offered.

Quarries of good flagstones, of a peculiar quartzy nature, and of great extent, could, I am persuaded, be opened at Cape Wollomai (Phillip Island); and, in connection with this subject, I may here express my opinion that this point is exceedingly well adapted for the establishment of a prison. Springs of excellent water are abundant on the very summit of Cape Wollomai, and in the surrounding neighbourhood, and ships can easily approach in the eastern passage to within a very short distance of the point in question, either for the purpose of obtaining cargoes of flags, or for the furnishing of supplies. A very small guard would serve for the protection of such a settlement, as both the insulated position and physical character of the country offer no chance of escape for the prisoners. The coast around the site which I suggest, is composed of fine-grained granite; and as I am convinced that no better situation for the purpose named could readily be discovered, I briefly recommend this proposal to the notice of the Government.

About one half-mile from the coal formation elsewhere described, is a site strikingly adapted for the establishment of a naval dockyard, and which has already been used for vessels of upwards of 100 tons. In the immediate neighbourhood, scarcely one hundred yards distance, are numerous clusters of box trees, whose crooked shapes render them well fitted for the construction of knees for ships. Abundance of fresh

water, entirely free from salt, can be obtained by digging in the sand about one chain from the beach, to the depth of about six feet.

At intervals about half a mile apart, on Phillip Island, may be observed curious conical structures, generally around an old stump.

Through this rotten stem the ants penetrate, making congeries of cellular passages, remarkable for their beautiful diversity. To secure their newly-found dwelling-place, the industrious little insects heap up a mass of firm clay around the stump, and which in time also becomes perforated with streets. This clay is from six to twelve inches in thickness, and the whole pile or cone is from five to seven feet in height. The ants themselves are very small, being scarcely 2-8ths of an inch in length.

A great variety of sponges are found in certain spots on the shores of Western Port Bay, but chiefly on the southern coasts; and although the present is a bad time of the year for obtaining them, I have nevertheless collected a considerable number, and about a hundred different varieties. The winter is the most favourable period for this purpose, as the tempestuous sea then detaches large numbers of them from the rocks on the bed of the ocean, and casts them on the beach, where many very fine living specimens may then be obtained.

Sponges of the finest quality for washing, and other useful and commercial purposes, as also coarse ones, well adapted to the cleaning of horses, vehicles, &c., can be obtained in abundance during the winter season on the shores of the whole southern coast.

Mollusca are by no means very plentiful along our coasts, and though I have for this reason been unable to obtain many specimens of the living animal, I have, notwithstanding, collected some hundreds of their shells. It is impossible to obtain a good collection of specimens in this branch of natural history without having a complete apparatus for the purpose, or, what is more feasible, employing an oyster dredger; and as my means are inadequate to justify an outlay for such a purpose, I am compelled to postpone a collection till more time and funds are at my command, for the fulfilment of such an object.

Oysters are abundant in Western Port; but during the months of January and February are of rather an inferior quality, these months being the spawning season.

The deep channels intersecting the mud flats or banks of the bay, contain a considerable number of curious shells; among these are different species of *terebratula*, nearly allied to *globosa*, and which, in the old world, are of rare occurrence, being found only on certain parts of the coast of Sicily. In many parts of Europe, however, fossil species are very common; nevertheless, the living varieties are found only in Sicily, Australia, and New Zealand; and inhabit only the deeper parts of the ocean, being seldom obtained at less than six, or in more than sixteen, fathoms depth.

The family of *patellidae* are very numerous along the whole of the Victorian coasts, and a great number of different species, some of them of considerable beauty, are to be met with.

The *emarginula Australis*, quite peculiar to the southern coasts of Australia, I found in considerable numbers on the shores of Phillip Island, although I was unable to succeed in obtaining any specimens of the living animal.

To the family of the *chitonidae*, belong but few species inhabiting our coasts. I have, during my excursion, found only two varieties; but there may be many others which escape my observation, as I am much too busily engaged, and my time is far too short, to pay any considerable attention to the conchology of the country. Engaged in pursuits of a more practical and important nature than that just mentioned, I am with reluctance compelled to defer any further investigation relative to this highly instructive and interesting branch of science. Concerning ichthyology, I have to make the same statement, as it is quite impossible for me to attend to so many different subjects at once.

Having been assured by some of the neighbouring settlers that I should be well repaid by a visit to Phillip Island, in obtaining many specimens of snakes, I must state that I was much disappointed in this object, as during my stay here, I observed neither snakes nor remarkable lizards of any kind; only a few common in all parts of the country.

Birds.—I chose the coast for my excursion at this season, partly for the purpose of observing the habits, &c., of the sea birds, the period of incubation having just passed over.

The young of the penguin (635, *Spheniscus minor*, little penguin,) and (636, *Spheniscus undina*, fairy penguin,) have nearly arrived at maturity, about the middle of January. Some few of these birds, however, do not begin to lay their

eggs until the latter end of that month. When caught alive the penguin defends itself with great courage, never making any attempt to escape danger: this, however, is chiefly attributable to the awkwardness with which it walks on land, the wings being required to support the body, and so used like legs. Hence its pugnacity is the only source upon which it can rely for its protection.

The nests of the penguin are very numerous in certain places along the southern coasts of Phillip Island, and consist of hollows burrowed in the sandy soil beneath some thick bush or scrub. It lays only two eggs at a time. The penguin is amongst the fattest of all the Australian sea birds; and this circumstance causes it to be very troublesome to skin, much time being occupied, and plaster of Paris consumed in freeing the skin from the fat which adheres firmly to it, and a large quantity of preserving matter being subsequently required to protect it from the attacks of insects.

The short tailed petrel (606, *Puffinis brevicandus*), or mutton bird of the colonists, does not form its nest at the bottom of the cliffs or sandy banks like the penguin, but prefers the harder sand above them. Both birds, however, select the same spots or parts of the shore, with the characteristic difference in their choice just mentioned. The nest of the petrel is formed on the open ground, quite unprotected by bushes, and slopes gradually down, to allow of the easy ingress and egress of the bird. It is much deeper than that of the penguin, the slope being sometimes five or six feet in length.

The eggs of the great petrel are of excellent quality, and during the month of December could be collected in cart loads at certain places at Western Port. Those of the penguin are not edible, as they possess a peculiar fishy and disagreeable taste, the yolk and white, moreover, being compounded.

These birds rise at the first dawn of light, and directly repair to sea in quest of food. They do not return till a considerable time after sunset, when darkness has completely set in; and during their prolonged absence, traverse the ocean wastes at a distance often upwards of one hundred miles from land.

January is the breeding month of these birds.

The petrel chooses the higher ground for facility of flight, and the penguin selects the lower position, that it may not have so great a distance to walk.

Three different varieties of hooded dottrell are found on the shores of the southern coast (472, *Hialicuta biancta*, double banded dottrell), (474, *Hialicuta manacha*, hooded dottrell,) (476, *Hialicuta nigrifrons*, black fronted dottrell.) These birds run extremely fast on the sand, making about six steps during the time a man would make one; they will for miles keep at equal distance from him without attempting to fly. They are usually found in groups of five or six, and seldom exceed the latter number.

Now and then two different species of rook's crane (one a snow white) (517, *Herodias gregii*), the other of a darkish bluish grey colour (516, *Herodias jugularis*,) blue reef heron, are observed on the coast. The common crane is also found in large numbers; but is very cautious, and consequently difficult to obtain; which remark applies indeed to nearly all the birds of this locality. Both the white and grey rook crane mentioned above, fly singly, and are rare birds.

A very similar species of sea swallow (570, *Hydrochelidon fluviatitis*) to that which exists in Europe, also frequents our shores.

It differs from the European variety only in size, being considerably larger than that known in England as the common tern. It flies at a considerable height above the sea, and at a very rapid rate, its powerful bill being pointed perpendicularly downwards towards the sea, in order that it may the more readily seize on any unwary fish which may make its appearance on the surface. The ferocious and demoniacal appearance of its eye, together with its long and sharp pointed bill, of an intense red colour, invests this bird with a truly formidable aspect. The moment it obtains a glimpse of its prey, it throws its body vertically over its bill, and thus, with its sharp form cutting the air, drops with the rapidity of lightning, and often from a very considerable height, seldom less than 100 feet, on its unsuspecting victim. The amazing velocity with which this is effected is such, that the observer has scarcely time to divine the cause of the sudden movement, and it is not before observing attentively several such precipitations, that the impression which it leaves on the eye is correctly understood.

Its prey being secured, the bird immediately rises again to the same altitude as before, and continues its flight, its fierce eye scanning the sea in quest of new victims.

The proportion between the length of the body (*i. e.*, from tip to tip, including the bill,) and of the wings (from tip to

tip, including the breadth of the body,) of all the aquatic birds of Victoria exists in its greatest extremes, as far as my experience goes, in the sea swallow and the penguin.

The proportions are expressed by the ratios 1. 2. 27. and 1. 0. 81. (standing respectively for the order in which they are named; the antecedent unit representing the length of the body.)

The courage with which the sea-swallow defends itself and young, and the cautiousness it displays at the same time, are truly astonishing. Not less marked courage does it exhibit when attacked by the osprey and white breasted falcon, as it almost invariably repels their onslaughts, and forces them to an ignominious retreat. The cry of the sea-swallow very closely resembles that of the gang gang cockatoo, and I have not unfrequently mistaken it for the last named bird. Their breeding places are on the small islands, in company with the pelican, the gulls, the oyster-catcher, and curlews, &c., which appear all united in the same social bond.

Three different varieties of gulls are very plentiful along the southern coast, in the more secluded bays. The great black backed gull (557, *Larus pacificus*, Pacific gull,) associates in pairs, being seldom seen singly, and generally cruises in the neighbourhood of its nest. It defends its young in the most affectionate manner, and even when the young one is taken, will refuse to leave the neighbourhood of the captor. Their companions also partake of their melancholy solicitude, and remaining close to the spot, may be shot and secured one after the other. The continual cry "on on" is well known to the seamen along the coast. They evince great courage in defending themselves from the ferocious assaults of the osprey and white breasted falcon.

The large grey gull is seldom seen, and only in groups of two or four. This species is much more timid in the defence of its young than the last mentioned variety.

The little white gull (558, *Hema Jamesonii*, Jameson's gull,) although numerous, is extremely cautious, and is, on this account, with difficulty obtained.

Two varieties of oyster catchers are observable on our coast. These birds generally associate in groups varying from two to five. The first species is completely black (464, *Haemotopus fuliginosus*, sooty oyster catcher;) the other is chequered white and black (463, *Haemotopus longirostris*, white breasted oyster catcher,) and is precisely similar to our European species.

The pelican (625, *Pelecanus conspiecillatus*) is found in great abundance in Western Port. During low tide these birds are seen on the mud flats at gunshot distances apart, wading about at the edge of the water in search of prey. At high tide they retire to the small islands which form their breeding places, and there digest their rich food, and attend to their young.

They can be seen at the distance of twelve or fourteen miles, and then appear like a small boat or white rock. The nest consists of a few sticks on the open places between the bushes. In these the young ones, which during the first month are perfectly naked, gather promiscuously together in groups of ten or fifteen, while the parents are in search of food.

The pelican lays only two eggs, which are perfectly white, of a considerable size, and of an elongated spheroidal or conical shape, both ends being exactly similar.

The weight of this bird averages about fifteen pounds, exclusive of food found in its pouch, sometimes two or three pounds in weight.

This food consists of small fishes, eels, &c., and is retained in the pouch affixed to the bill, for the purpose of carrying it to the young. I am inclined to think that instead of catching each fish individually, the pelican dips his long bill into the mud, and filling his capacious pouch, washes the mud and shells away. Thus freed from sandy or muddy particles, the fish remaining are either retained in the pouch for the purpose above-named, or are taken into the stomach. The stomach itself consists of a large pouch, containing a large number of glands.

The timidity of the pelican is striking, especially when compared to the courage displayed by the smaller birds around him. At the least danger he leaves his nest, and, if alarmed, will not return for at least two days, as I have watched during that time both day and night, for the purpose of observing their habits, &c., in the scrub of a small island, scarcely one acre in extent, on which they were plentiful. The black backed gull, in the absence of the pelican, generally defends the nest and young of the latter against the fierce assaults of the raptatores.

The Cape Barren goose (539, *Cereopsis Novae Hollandiae*), although extremely scarce in these districts, is, nevertheless, sometimes observed upon the insulated rocks along the south coast of Phillip Island.

The black swan (544, *Cygnus atratus*) is very plentiful in Western Port and the fresh water lagoons of the southern coast. When exercising their young, the female cautiously leads the way, followed by the young ones, and if any of the latter are seen to loiter, they are sharply reproved by the old male bird, who follows behind. If the female takes alarm, she turns quickly back, but the male, while unaware of the danger, compels her to resume her place. The moment, however, that he himself becomes acquainted with the cause of alarm, he immediately turns back, and swims with great rapidity from the seat of danger. At this juncture the female appears either stupified with fear, or in anxiety for her young brood: she waits to discover the actual danger, as she generally remains behind, and becomes a victim to the aim of the bushman.

In the beginning of February, which is the month in which the black swan moults, the old birds lose their wing feathers, and for this reason remain almost continually in the water. At this time, too, the young have fully arrived at maturity, although they are not yet capable of extended flight, and still require the protection of their parents.

Western Port is visited by large numbers of shags (617, *Phalacrocorax subeirostris*, groove-billed cormorant, and 620, *Phalacrocorax melanoleucus*, pied cormorant), of which only two different species have come to my knowledge.

They are very expert at diving, and remain a long time under water. I have myself counted to 130 many times over during the stay of a shag below water, which appears about the limit of his stay under water.

At low tide the extensive mud flats which then appear above the waters of Western Port Bay are covered with birds of every description mentioned above, and present such a novel appearance as to suggest the idea of the original state of the animal tribes within the plains of Paradise.

Those extremely shy birds, the curlews (498, *Numenius Australis*), are very plentiful along the southern coasts, but are so difficult to obtain that, unless a brush fence be erected, it is quite impossible to get a shot at them, and even then extreme caution is required in order to succeed.

The family of *falconidæ* is very numerously represented in this part of Victoria.

Six different varieties of hawks and falcons inhabit the islands of Western Port Bay, but as they are very cautious, and give but few opportunities for observation, I am unable

to state much concerning them, but must wait till more experience gives me a further knowledge respecting them.

The white-breasted falcon (7, *Falco hypoleucus*) and the osprey (6, *Pandicin leuceocephalus*), although numerous, are very difficult to obtain, owing to the quickness of their sight and extreme cunning.

I have obtained two different species of owls (31, *Strix delicatulus*, delicate owl,) and (32, *Athene Boobook*, Boobook owl) on Phillip Island.

At Mrs. King's station I found two varieties of water hens.

On the 25th of January my camp, on the north side of Phillip Island, was visited by large flights of the great swift, (50, *Cypselus Australis*), which did not wholly disappear till late on the ensuing morning.

In this report I have not brought forward the several notes and observations I have made on the birds, &c., which have come under my knowledge. The substance of these relates to,—

1. The food.
2. The tongue.
3. The stomach.
4. The colour of eyes, bill, and feet.
5. The weight.
6. The relative sizes and lengths from tip to tip.
7. The number of feathers in 1st, 2nd and 3rd order, and scientific description of the plumage directly after the specimen is shot.

These notes will no doubt become valuable to the public after the lapse of a few years; but I have not brought them forward in my reports, since much further experience concerning each specimen is required to ensure the correctness desirable in the position which I have the honour to occupy.

The information I received from different parties respecting the ease with which seals could be obtained on Phillip Island is incorrect, as from experience I am now able to state that, although seals exist on the islands and insulated rocks on the southern coast, it is impossible to approach them without an experienced crew and a good boat, on account of the rocky and precipitous nature of their retreat, and the heavy surf continually rolling in from the great Southern Ocean.

The hoarse groaning roar of the seal can be heard at a great distance, and to the person engaged in hunting them is

not a little exciting, especially when the want of the means of approach precludes him from attacking them.

In January the seal is already accompanied by young ones.

The water rat exists in the lagoons on Phillip Island in considerable numbers, but appears to me to be much smaller than the species of the main land. In January I observed five fœtuses from the womb of a female.

The brush tailed or white tipped wallaby exists in great numbers on Phillip Island, particularly on the eastern side, but in the last-named direction it appears to be of a lighter grey colour than that on the western portion of the island.

The wallaby frequents the low scrub and fern, and retreats for safety in the dense tea-tree scrub in the moist places.

It is not unfrequently, however, found grazing in the more open grassy plains.

When alarmed it raises its head, which is alone seen over the fern, and gazes stupidly at the approaching sportsman, who in such circumstances obtains an easy shot. In the more open places, however, the animal better appreciates the danger, and speedily disappears at the least approach of the sportsman. Towards evening they come out of the forest, and are frequently observed wading about at the edge of the sea, especially near the mangrove trees growing in the water. I have made this observation, and so often watched their actions while in the water, that I think it probable that the animal occasionally drinks salt water.

The hind quarters of this animal are much esteemed by the inhabitants of the bush, and possess a taste not unlike hare.

The male wallaby is the most vigilant, the female being invariably the last to take alarm.

The pouch of the virgin animal is remarkably small in comparison to those which have already produced young ones.

The stupidity of the wallaby, especially the female, is so great while feeding that I have shot a male and female successively, while the latter was grazing along with him, and did not offer to stir, but still continued grazing after her companion was killed beside her.

It is a very remarkable fact that the wallaby is the only species of *Marsupialia* which exists on Phillip Island. What is still more remarkable, the shores of the mainland opposite this island swarm with multitudes of hungry wild dingos,

and yet, although a very narrow passage divides the two shores, no wild dogs are found on this island.

The other islands of Western Port do not even possess the wallaby. The simplest way to account for the existence of this animal on Phillip Island is to suppose that an extensive bush fire, travelling westward, drove them over from the mainland. As before mentioned, only a very narrow passage (in one place scarcely more than two chains in breadth) separates the island from the mainland. However, if it be admitted that the wallabies have swum across, there is no reason why the dingos and other animals should not have done the same. At any rate the very circumstances exhibit several extremely remarkable facts, especially with reference to those other islands, which are completely destitute of all the Australian quadrupeds.

The skins of the wallaby and kangaroo are useful for the purposes of the currier, and of considerable value on that account, being sold at 16s. per lb. Both these animals abound in such large numbers in the Western Port district as to be a perfect annoyance to the settlers of those parts, and, under these circumstances, I think the collecting of skins offers a remunerative source of employment to a considerable number of men.

The skin of the kangaroo, while in an unprepared state, weighs from twelve to fourteen pounds, after being submitted to the process of tanning, from eight to ten pounds, which facts, I conceive, fully bear out the correctness of my remark. Eighty or ninety pounds of saleable meat is often obtainable from a single specimen, and as, moreover, a number of "Joeys," or young ones, for which captains of vessels proceeding to Europe pay handsome sums, are frequently caught with the old ones, it would not require great intelligence, or even labour, to obtain a good living by the means above stated, especially as there are a considerable number of vessels communicating between Melbourne and Western Port.

As before mentioned, the wallaby is found scattered over the whole of Phillip Island, but is especially numerous on the eastern portion.

This preponderance eastward seems but a miniature representation of that great law of nature observed on the older continents, viz.,—That while the animal world becomes more developed and increases in actual numbers westward,

to the east all appear to diminish and disappear in the lists of species. The rule applies as well to Australia as to the continents of the old world, but is marked with this striking difference, viz., that the order of progression is here reversed, animal life increasing eastward and diminishing westward. It is far from improbable that the sun exerts some secret influence in thus drawing animal life eastward, as after a cool night the animals would naturally choose that direction approaching the sun to warm themselves in his rays, and in this manner continually creep eastward. This conjecture does not apply to the older continents, as there the warm winds proceeding from the westward counterbalance the heat derived from the genial rays of the sun. Civilization, too, in the older continents travels eastward, while in the Austral hemisphere the order is again, singularly enough, reversed; here we may flatter ourselves that it creeps westward. Thus it appears to gain ground precisely as the animal development becomes less, in other words, where the resistance to it diminishes.

Art. VIII.—*Irrigation.* By F. C. Christy, Esq.

Irrigation being a branch of engineering much overlooked in this colony where it would be of the very greatest possible service if properly and judiciously introduced, I have taken upon myself to write a few lines upon the subject, not so much with a view of submitting plans, or of affording any great amount of information upon the subject, as to elicit from others who have had more experience than myself, the method adopted in other countries; for my knowledge is confined to the flooding of water meadows in England. I have also had very little opportunity of seeing the colony of Victoria generally, but the little I have seen, has struck me with the vast importance of irrigation. On the Geelong side there are very extensive plains, which are of the richest soil (basaltic). These plains being exposed to the full effects of the sun's rays, become parched up in summer, so that there is neither pasturage for sheep nor cattle, neither can they be tilled to any advantage. The grass which grows upon them in winter becomes parched, dried, and bleached, almost to whiteness, consequently the reflection from the sun is so great, that it is dangerous to be exposed on them during

some of our hottest days. These plains have the rivers Moorabool and Barwon on the southern side, and the Little River running through them nearly centrally, and the River Exe to the eastward. The River Moorabool comes over the Moorabool Falls near Mount Buninyong, at an elevation 1560 feet above the level of the sea, and from thence pursues its course through Fiskin's Large Swamp, which contains about 500 acres, and is completely hemmed in on all sides by high slaty ranges: it is here that one of the grandest reservoirs has been formed by nature. The river makes its exit from this reservoir through a narrow pass in the ranges. The surface of this reservoir is at an elevation of 1266 feet above the level of the sea, and about 700 or 800 feet above the plains. The country towards Geelong and the Plains is moderately level, excepting the inclination, so that there would be little difficulty, in my opinion, in leading the water out of this reservoir in courses, or open channels, over a great portion of these plains, thereby converting them (now almost waste) into the most fertile land in the colony. The river flowing in and out of this swamp through such a narrow and highly banked channel, may be permanently damned up at a moderately small expenditure, for the ranges rise abruptly on each side, and are of a hard irony silicious clay slate, so that they would resist any pressure from a dam built on an inward curve, which, if well built of stone and puddled, no floods could move. I think it is probable that a depth of from 50 to 100 feet might be obtained in this one reservoir; and besides this, there is another about one mile below, of about half the size, viz. Eerton's Swamp, which might be also converted into a reservoir under equally favourable circumstances. I have not measured the volume of the river, therefore cannot even approximately estimate the annual flow through these swamps, but it must be, from what I have witnessed of the river in winter time, something enormous, which now, in time of floods, rushes down the river, and causes it to rise as much as 20 feet, as witnessed by my party at Batesford in December last, when it rose at the rate of $1\frac{1}{2}$ feet per hour, or 18 feet in twelve hours, sweeping all before it, and discharging itself into the sea, without benefit to any one; whereas were these floods husbanded, and allowed to flow in quantities as required by the consumer, to what incalculable worth might those floods be turned, which now only injure operations upon the river, and polute the water for sanitary purposes; but were they retarded by the

reservoir, the water would deposit the earthy matter, and flow down in a clear and pure state. It is impossible for me here to give an idea how far down the present river channel might be used for conveying the water for irrigating purposes; but from the precipitous and rocky nature of its banks, and from its narrowing so frequently, I am inclined to think it might be damned for almost all districts, so as to make it overflow its banks, and thereby lead branch channels in the direction required. There is one point certain, viz., obtaining a constant supply down its channel; whereas, in dry summers, it almost ceases to flow, and becomes so nauseous, partly from getting brackish, and partly from the water holes becoming stagnant, and containing so much dead timber, which has from time to time been hurled down by the water torrents, thereby imparting a flavour of the eucalyptus. Timber or stone may be obtained for damming on most parts of the river, which only require engineering skill and labour to convert them. As this paper is only written for the purpose of inducing discussion upon the subject, I shall not now attempt to enter into the more practical part. There is no doubt that there are numbers of other parts of this colony where irrigation would be equally, if not more effectually supplied: but this particular district has come under my notice; for I have stood in Fiskin's Swamp, and thought how splendidly nature had done her work, and how little was required from the hand of man to convert that rich pasturage (now the retreat for the mobs of cattle which run wild in the ranges) into probably one of the finest reservoirs in the world. I say finest, because unlike the Yan Yean, a comparatively unlimited depth may be obtained. It would be almost impossible to estimate the extent of fertility irrigation would produce upon the rich soil of the plains; therefore I shall leave this portion of the subject to those who are more able to treat the matter than myself. There is this advantage in irrigated land over swamps and marshes, which are at present the most fertile portions of the colony. Swamps are generally covered with water in winter, consequently cold, and vegetation retarded until late in the year, when the swamps become frequently dry and parched. Irrigated land may be kept dry in winter, for the very channels which supply the land in summer with water, may be converted into drains in winter; and in summer, when swamps are dry, and moisture much needed, this land may be flooded. But any one who has seen the effect produced in England upon

the water meadows by flooding, will know how to estimate the value of irrigation upon such a parched but rich soil as this. But there must be many persons in this colony who have witnessed the effects of irrigation in hot climates, and I hope that this short paper may induce some of these persons to come forward, and add their knowledge to the subject. The River Moorabool gets its supply of water from the surrounding ranges about Bungingyon, Lal Lal, Egerton, &c. Two arms—the Moorabool and Lal Lal—join and form the river: each of these arms fall over precipices of basalt about eighty feet deep perpendicularly. The Lal Lal Falls are probably more than eighty feet high, and beautifully columnar in their formation above and below these falls. Granite is abundant, but there is none in the immediate proximity with the Falls. There would be very little difficulty in ascertaining how far these plains could be irrigated directly from the present channel of the river, as sections have been taken for the Geelong and Balaarat Railway, which runs only a few miles from the river nearly the whole way, so that cross levels might run out from these sections, and the facts easily obtained. Should irrigation be introduced into this colony, I have no doubt but that it would bring with it the cultivation of many commercial vegetable products at present unknown here; it being at present impossible to produce them from the scarcity of water, and which cannot be cultivated without a constant supply of water during the period of their growth. In conclusion, I beg to remark that probably in a short time levels will be run through the whole of the colony, for the purpose of railway communication; and it will be an easy matter to ascertain from those levels the fall of the different rivers, and what portions of the colony could be practically irrigated.

ART. IX.—*Some Observations on Primary Schools.* By WILLIAM E. HEARN, LL.D., M.A., *Professor of History and Political Economy in the University of Melbourne.*

THE subject of Primary Education is confessedly one of extreme importance and extreme difficulty. There is no public question on which, as regards the general principle, men of all parties are so fully agreed, and yet there is none on the details of which so much difference has arisen. Of all our social difficulties that of education is probably the one for

which the public would most thankfully accept a satisfactory solution. I will not undertake to perform a task which so many wise and good men have failed to accomplish, but I wish to call attention to some conditions which seem necessary to the efficient working of elementary schools, and which have hitherto been too much disregarded.

Both the Educational Boards which exist in Victoria have been most zealous in promoting the objects for which they have been established. They have been indefatigable in building school houses, in founding new, and improving old schools, and in raising the standard of attainments among their teachers. Yet it is, perhaps, from this very energy and zeal that they have failed to observe the defects of their system. A bad system, well administered, possesses a considerable amount of vitality. If, however, it is painful to see a well contrived scheme spoiled in the hands of blundering officers, it is not less painful to witness the waste of skill and earnestness of purpose upon a system which is radically unsound.

I have said that both the Educational Boards bestow great and laudable pains upon the improvement of their masters. We have now to see what is the task for which they thus train them. If we enter any ordinary school we shall see a solitary master in charge of fifty or sixty children. Except in those cases where an infant school is attached, the ages of these children range from three to thirteen years, and their attainments vary from a very indistinct notion of their alphabet, to book-keeping, or, perhaps, geometry. It is not too bold an assertion, that to teach properly so many and so differently circumstanced children is wholly beyond the powers of any one man. The children must, of course, be roughly divided into classes; only one class can be heard at one time; the other classes remain at their seats; the master is distracted between attending to his class and keeping order among the unemployed, and is thoroughly wearied in attempting to discharge a duty which ought never to have been imposed on him. If we continue our observations we shall find that the same scene is repeated, with very slight variation, in some six or seven other schools, all of which are generally within a very short distance of each other.*

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* The following figures, which are taken from the last report of the Denominational Board, will shew the correctness of this statement:—That Board had under its charge, in 1854, 213 schools. The average number on the roll in these schools was 67; the number of teachers of all classes, including pupil teachers, was 344, or rather more than one and a half to each school.

It is true that there are many schools wonderfully well conducted, and many able, earnest, and successful teachers. If there were not such men, the system would have long since been exploded. But we might expect very different results from those which we at present witness, if such men were relieved from their present cruel position, and if they received full scope for the exercise of their respective powers.

It sometimes happens that the mere statement of a grievance suggests at once the appropriate remedy. It is so in the present case; if we wish to increase the efficiency of these schools we must combine them. It would not be easy to find any system more thoroughly unscientific than the present. It is by the combination of labour, by the united exertions of many persons working together at the same time and in the same place, that we obtain the maximum of power; it is by the division of employments, by the assignment of a separate function to a separate class, that we obtain the maximum of skill. In any occupation, therefore, the quantity of work done will be increased, and its quality will be improved, in proportion to the increase of the classes of workers, and to the increased number of workers in each class. This law, so universally acknowledged, and in our daily practice almost instinctively carried out, is altogether disregarded in our present system of education. That system divides where it should combine, and combines where it should divide. In place of the combination of labour, and the divisions of employments, it gives the division of labour and the combination of employments. It divides labour to the utmost possible extent, for it reduces it to that of a single head; it combines employment to the greatest extent of which the case will admit, for it compels one master to teach children most widely differing in their years and their attainments. What the simple but unbending principle to which I have referred requires is, that we should have one school with seven masters, rather than seven schools each with one master.

The first and most obvious result of this change would be a great reduction in the number of teachers. It is well known that in many cases two men, when acting together, can do more than six when acting singly. Those who are acquainted with the practical administration of schools, know that two masters together will have less difficulty in managing eighty boys than in conducting two separate schools of twenty each. If the attention of the master be confined to a single class, of the same attainments, his power will be in-

creased. The same exertion which is required to produce any single result is often sufficient to produce many similar results. It is nearly as easy to carry twenty letters to the same place as it is to carry one. It is not much more expensive to print a hundred copies of a book, than it is to print fifty; so a teacher, who is nearly helpless among fifty boys, of various ages and degrees of proficiency, may be in a very different position among even one hundred boys of similar standing and attainments.

The extent of this saving will be more clearly seen by taking an actual case. There are usually four classes in the ordinary schools. There are about four hours each day of secular instruction; each class is, therefore, about one hour with the master. There are six denominations, and therefore there are often six Denominational schools, and at least one National school, in the same district, each under a separate master; if there be one school with seven masters, instead of seven schools each with one master, each of the four classes will have a separate master for the whole of the four hours, and three masters will remain unemployed. The masters could easily deal with the increased classes, when they were of the same kind; but, if any class should prove too large, or if it were found undesirable to keep the children so long at class, the master could make such a sub-division as would best meet the requirements of his pupils.

A much more important consequence than any reduction in the number of masters, would be, the increased amount of instruction which the children would thus receive. If we allow for the necessary sub-division, it will not be too much to say, that a child should do as much in one month, under this system, as he now does in three. The tendency of parents prematurely to withdraw their children from school, is one of the great obstacles against which the teacher has everywhere to contend. In Victoria, the temptations to such a step are unusually great. It is, therefore, necessary for all teachers, but for us most of all, wisely to economise the time during which the children remain.

Another benefit which would naturally follow from this plan would be, that each master would be able to devote his entire attention to one particular class of children. It is not hard to understand that teaching geometry is a different thing from teaching the alphabet. The most experienced college tutor would be at a sad loss in an infant-school; and it is not to the managers of infant-schools that we are in-

clined to look for efficient instructors of the adult. If teachers were to devote themselves to separate parts of the different branches of a school education, we might well believe that they would soon acquire an amount of skill in their respective departments, far beyond anything to which we are at present accustomed. Nor let it be said, that the narrow limits of primary education afford no room for elaborate subdivision. Both Mr. Babbage and Mr. Mill refer to the fact, which was stated in evidence before a committee of the House of Commons, that the construction of a watch is the result of one hundred and two perfectly distinct occupations. We ought not, then, to grudge five or six similar distinctions in the education of our children.

We can seldom foretell all the advantages which follow from the application of any sound principle. In the present case, however, there is one so unexpected, yet so important, that it must not be overlooked. It is possible that, while we have been considering merely the best means for increasing the efficiency of our schools, we may have stumbled upon the solution of that perplexing problem, which seeks to reconcile the conflicting claims of a united and a religious education. It is needless to refer to the unhappy disputes which have parted, both in this colony and at home, many good and earnest men, all truly anxious to promote the education of the people. With a real difference subsisting, the advocates of the rival systems have yet much in common. The Nationalist insists that all education should be united; the Denominationalist, that all education should be religious. The National Board protest that religious instruction is actually given in their schools; the Denominational Board* congratulate themselves when they make an approach to union. Neither denies the principles which the other supports, but each attaches a different value to those principles. Both parties would doubtless rejoice if any means could be shown, by which this much-vexed question could be set at rest. Such a method may, perhaps, be found in the arrangement which I have suggested. If, when the schools were combined, the masters in each school were to represent the different denominations, there could be no difficulty in giving to the children of each denomination such religious instruction as their respective clergymen should direct. The schools are open for five hours daily. During one hour, each master

* See their Report for 1854-5, page 9.

might have for his class all those who professed the same creed with himself. During the remaining four, the children would be divided—not by creeds, but by ages—and would receive secular instruction, without any reference to religious belief, from the masters appointed to preside over each class. The education would thus be separate as far as it was religious, and united as far as it was secular.

The following cases will illustrate my meaning:—The last Report of the Denominational Board (p. 6,) points out the necessity which exists in this colony for upper departments in schools, and observes that the only apparent method of effecting this object is, "to provide a master for the common schools, of such abilities as shall enable him to carry on the higher branches of education, while he either superintends or conducts the lower part of the school." In this case, where additional efficiency is sought, it would be desirable to appoint to the school a second master, who should have the especial charge of the more advanced classes. To select a good scholar to teach some fifty children, at the same time, all the variations, from the alphabet to the higher branches of education, would be, indeed, to place Pegasus under the cart.

Again, in Canada, as in our mixed schools, teachers are appointed with a due regard to the religious opinions of the local majority. If the minority be dissatisfied, they can establish a separate school. But they receive in aid of their exertions only a certain sum for the teacher's salary, and they are not exempted from any of the local assessments or rates for common school purposes. In this case, where religious security is the object, the addition of a second master of a different creed would attain that object—would save the expense of building and furnishing a second schoolhouse—and would greatly increase the teaching power in the district.

The plan which I have suggested is by no means unsupported by precedent. Mr. Kay,* in speaking of the primary schools of Saxony, states, "that in the town-schools there are generally eight classes, instructed in eight separate class-rooms, four for boys, and four for girls; that the fourth class contains the least, and the first class the most advanced of the children; that each class is under the charge of a separate teacher." The same writer elsewhere (p. 68), points out the

* "Social Condition and Education of the People in England and Europe," II. 253.

point, however, we must trust to the good sense and the good feeling of both the clergy and the laity of all denominations; and we must hope that they will not be indisposed to make some slight mutual concessions, if there is a reasonable prospect of effecting a great general benefit.

Another difficulty may arise in reference to the school accommodation. The concentration of schools would require a different arrangement of school-houses from that which their dispersion necessitates. This objection, however, only applies to those houses that are actually built, and has no reference to future operations. It has, too, at present less weight than in a few years hence it might justly claim. Excepting those in the towns, the school-houses throughout the colony are seldom edifices of so costly a character as to present any serious impediment to the execution of our scheme. Where there were superfluous houses and reserves, the most obvious course would be to sell them, and apply the proceeds to the erection of suitable buildings. In some cases it might be possible to render the existing buildings available, by devoting separate houses to separate classes. Each school-house would then become a class-room. In this way, if a child of six years old applied for admission at a school where children of twelve years of age were taught, he would indeed be taken, but would be at once transferred to the neighbouring school-house, which was appropriated to the children of his standing.

Again, it may be said that in thinly-peopled districts this plan could not be carried out, except at an extravagant cost. It is quite true that in such districts we cannot expect so complete a division as in more populous localities. The division of employment is limited by its market. But neither in the town nor in the rural districts would it be necessary to have each denomination represented in each school. Such representation would depend, as it in fact does at this moment, upon the religious elements in the population. For instance, of the 32 Denominational Schools in Melbourne, there are three which belong to the Church of Scotland. If those 32 were reduced to 11, it would not be necessary to have a Presbyterian master in each school. It would certainly be desirable that each denomination should be actually represented in every school. The true test, however, of the number of masters, would be the efficiency of the school. When that question was determined, the next consideration should be the religious character of the surrounding population. Care should be taken that the masters represented the

improved classification and the economy in buildings to which this combination in town-schools gives rise — advantages which are rendered more conspicuous by their total absence in the country districts. (See p. 203.) He also states, that in mixed schools, when two teachers are required, they are elected, each by a different sect, and that each conducts the religious education of the children of his own creed.

I shall now briefly consider the objections which may be urged against this scheme. The first is, the probability that the masters, differing from each other in creed, and mutually independent, would continually quarrel with each other. As far as the difference of religion is concerned, there is no reasonable ground for apprehension. Experience has fully shown that men may hold different creeds, and yet live very happily together. I have been for years connected in daily intercourse with men who differed from me in religious belief, and yet we never had the shadow of disagreement. The Model School in this city presents another instance. It happens, although from mere accident, that the masters in that establishment represent almost all the leading denominations, and yet I believe that this difference has never given rise to a single dispute. At the same time, in such a case, the masters who belong to different creeds, act as a check upon each other, and thus give the public the best security against any undue interference.

I am, however, well aware that, apart from all religious differences, jealousies and disagreements are only too likely to arise among men placed in the circumstances of independent teachers in the same school. This difficulty would be in a great degree met, by bringing, in each school, all the fees into one common fund, and sharing that fund in stated proportions among all the masters. They would thus all become partners in the business, and would all have a direct interest in its success. It would probably be prudent to give one of them a higher salary and position, and to hold him responsible for the general discipline of the school.

It is possible, also, that the patrons of the separate schools, and especially the different religious bodies, may feel reluctant to admit other parties to a share in the management of their schools. No material change, however, in the local patronage of the schools would be requisite. Besides, if something should be taken away, an equivalent would be given. It would not be less desirable to be joint patrons of a large, than to be sole patrons of a small, school. On this

prevailing denominations. At present, in the country districts, the schools are either National, or one denomination only is represented. I have already shown the reduction which might be effected in the number of masters. Some of these supernumeraries might be sent to assist in the rural schools, and thus, without any additional expense, every school in the colony might have at least two masters, and in every district two denominations, if not more, might be represented.

It is probable that the public would not regard even a considerable increase of cost as a serious objection to any plan which would obviate all the difficulties which have hitherto impeded the progress of National Education. But in fact the system of concentration would probably be found not only more efficient, but much cheaper than the system of dispersion. It is not merely in the substitution of a single for a double management, nor in the reduction of masters, nor in the number of buildings, nor in the quantity of public land which the present system requires, that the saving would be found. In such a system as I have described, the quality of the education would be so much improved, that it might be expected soon to become almost, if not altogether, self-supporting. There are, indeed, some who would not regard this result as an advantage, and would prefer to offer to the public a perfectly gratuitous education. I believe that gratuitous education is good neither for the pupil nor the teacher. The latter has no personal interest in the success of his school: the former values but little that which cost him little. It is not cheap education, but good education, that the people want. On this subject we have some remarkable evidence. In King's Somborne, a poor agricultural parish in Hertfordshire, the present Dean of Hereford took great trouble to improve the education given in his school. In a short time the school became self-supporting, and has continued so for several years. In order to test the accuracy of his views, the Dean doubled the school fee, and he found that the labourers gladly paid the increased sum when they were satisfied that they were really getting value for their money. On the contrary, in New York, where education is wholly gratuitous, and where the school-tax is very heavy, not more than one-third of the children whose names are on the roll, actually attend. It is the boast of America, that the highway is not more free to every citizen than the schoolhouse is to every child, and that for no other object do her

people so heavily tax themselves as for education. It would be, perhaps, a prouder boast for Victoria, if even the poorest parent should find it worth his while to pay for the education of his children, and if schools, soon after their establishment, should cease to require assistance from the State.

The same principle which we have thus applied to our system of education, will also apply to the manner in which that system has been administered. In the two rival Boards of Education, we have a sufficiently obvious instance of divided labour and wasted power. If the cause which leads to this division were removed, the two boards, without doubt to their own gratification, and to the great advantage of the public, might at once be amalgamated. I have no doubt that, in their united character, they would soon present another illustration of the benefit of the *combination of labour*. But it is well known that an honorary board is by no means the best administrative instrument. It is always slow and difficult to work: it is generally composed of persons who are fully occupied with other and more pressing duties. It is ungracious to find fault with gratuitous services, and the responsibility, by being divided, is proportionately weakened. All these difficulties are aggravated, when the subject-matter of their charge involves an amount of special knowledge, which is hardly to be expected in persons engaged in uncongenial pursuits. It is at the same time desirable that the various religious denominations should be represented, as well on the central as on the local boards. But this object may be obtained without any sacrifice of efficiency The general administration of the department should be entrusted to a small bond of salaried officers. Such a board might readily be formed, with very little additional expense, from the chief officers of the educational departments. From this body an appeal should lie to a Board of Visitors, composed in the way in which honorary boards are usually constructed. It is not likely that the visitors would often be required to interfere; but the mere existence of the right would afford the desired security. This system is in force in the Queen's Colleges in Ireland. These institutions are managed by a council, elected by the professors, and an appeal from their acts lies to an Honorary Board of Visitors, composed of the representatives of the different denominations and the principal professions. These arrangements have worked admirably. In this separation of functions, we have again the *division of employments*.

Such a Board of Education, undisturbed by a ruinous competition, composed of men skilled in their work, and devoted to it, and supported by an enlightened public opinion, would render greater services than we might at first sight suppose, towards the general diffusion of knowledge. It might at least help to establish an asylum for destitute children, and a reformatory school for juvenile offenders. It might render valuable assistance in promoting adult education. In some parts of Germany, evening classes for adults are held in the school-house, twice in the week. In the Austrian empire, the numbers in attendance on these repetition classes, as they are called, amount to nearly 700,000 persons. With competent teachers, what is to prevent a similar practice in Victoria? But the most important task of the Board would consist in raising the office of teacher to the rank of a regular and acknowledged profession, and in training its teachers to be worthy members of that profession. Such a reform could not, from its nature, be immediately effected; but the foundation of the system could readily be laid. No effort should be omitted which might tend, however indirectly, to secure the independence of the Educator, to increase his skill, to stimulate his professional sympathies, and to protect his profession, as other professions are protected, from the discredit which the intrusion of unqualified practitioners occasions. By these means, a better class of men will be induced to take charge of our schools, and the hands of the teacher will greatly be strengthened, when he occupies that social position to which he is so well entitled.

I have endeavoured to show that there is at least a possibility of a comprehensive system of public instruction. I have pointed out that the increase of schools does not necessarily imply the increase of education. To effect that object —to render a really good and useful education universal—we must make the education which we offer really good and useful. But as in physical, so in social science, nature, when she has been conquered by obedience, always gives us more than we desire or deserve. We may well, then be gratified, although we can hardly be surprised, if we find that the means of rendering our system of education thoroughly effective, should also prove the means of rendering it at once united, religious, and self-supporting.

ART. X.—*The Importance of Sanitary Works for Towns, having especial reference to Collingwood; with suggested Remedial Works for that District.*

By THOMAS E. RAWLINSON, C. E.

IN submitting to the Institute the following paper on the importance of sanitary works for all town lands, but having especial reference to Collingwood, I will introduce the subject by a few prefatory remarks on the evils that have resulted in older and more settled communities from a neglect of drainage works generally, and some of the consequences arising from the want of the necessary arrangements for the same being properly attended to and carried out.

The vast and paramount importance of a serious consideration being given to the general laws of nature under which we live, and of the stern moral duties required of us, not only to obey, but also to enforce compliance with such laws, is, I trust, too generally known, and too strongly impressed upon all, to require me to occupy the time of this Society by any lengthy remarks on the subject; but, for the information of such as may not have given this question much consideration, I will briefly allude to a few general facts which are on record of some of the terrible visitations under which the human family have suffered in consequence of their ignorance or neglect of suitable sanitary arrangements.

After a careful perusal of such records, it will be apparent to any candid inquirer, that it is not alone sufficient, to enable man to retain bodily health and vigour, that he should have abundance of the necessaries of life, as understood by the terms "food and clothing," for, some of the most devastating pestilences have occurred where there has been no lack of either. Food and clothing are certainly essentials to health, but they can only be regarded as conditions, in conjunction with the almost equally important requirements of weatherproof habitations, a pure atmosphere, well-drained houses and lands, and the means of cleanliness in house and person; for we have high wages and squalor in manufacturing towns, contrasting painfully with low wages and robust health in the country.

To the absence of some or all of the above-named requirements, must be attributed all the recorded pestilences, whether

endemic or epidemic, of which we have any authentic accounts.

From the narratives left us of such visitations, we learn of large and important populations, having in more than one instance been decimated or swept away in the course of one short season; of an army of 30,000 men having been annihilated in three weeks; of ships floating about at the mercy of the winds and waves, in consequence of their crews having been suddenly summoned to their long account; and of churchyards being unable to contain their dead. At Constantinople, in the year 746 A.D., 200,000 of its inhabitants died by pestilence; and again, in 1611, a like number perished in the same city from the same cause; whilst in 1656, in the Neapolitan States, 400,000 persons died of pestilence. It is estimated that in the Great Plague of London in 1665, not less than 100,000 people perished miserably. History is so crowded with such horrors, that the heart sickens and shrinks back appalled at the bare recital of only a summary of the results. War is a dreadful calamity to any nation; and the blood-stained field of battle must be a fearful scene, speaking, as it does, of human suffering and woe; but the whole sinks into insignificance, when contrasted with the desolate, protracted horrors of a plague-stricken city. The bullet, the bayonet, and the sabre, are evils short, sharp, and quick in the work of destruction; but who shall compare them to a lingering death-bed torture, in a close foul room, the body enfeebled with disease, the spirits bowed down with suffering, and perhaps the added agony of seeing loved relatives and friends also suffering and sinking under the same dread maladies. To thinking minds, the dreadful tragedy becomes of intensely painful interest, when it is known that such visitations have their origin in causes which are under our own control, and are the results of ignorance and neglect. It is as impious to term such visitations a judgment from the Almighty, (who has created nothing that is not good,) as it would be to record, "Died from the visitation of God," upon the wretched suicide who rushes unbidden into the presence of his Maker.

Of late years we have had the fearful cholera, visiting at intervals nearly all the states of the known world, leaving its terrible memorials behind in desolate homesteads and teeming churchyards; but, even whilst we are comparatively free from the ravages of the more speedy epidemics, we have always resident amongst us endemics in some of their Protean

forms of typhus, scarlatina, or other malignant fevers, wherever human beings are congregated together in towns or villages, without regard to the general conditions of health, as before set forth.

So perfectly unvarying is the rule, that it has passed into a proverb with those conversant with such questions, namely, "Show me a dirty undrained locality in your town, and I will show you the seat of perpetual debility, and fever, and death."

There can be but little doubt, that it is owing to the vast strides which civilization has made during the past thousand years, that the great improvement observable in the general health of the nations of Europe is due. The importation of a greater variety of food, of a greater abundance of materials for clothing and use, in the arts of civilized life, and the immense development and application of labour-saving machinery by which such imports can be made available at a small cost to the artizan and labourer, equally with the capitalist, have now rendered much of the discomfort and privation, which formed a general feature of the social life of the Middle Ages, a matter of history only. With the increase in the comforts and conveniences of life, the tone of society has improved, and we have reason to believe it will continue to improve as the causes detrimental to health are removed.

Much has been effected of late years by a few noble-minded men, who have banded together for the holy purpose of inquiring why so much sickness, sorrow, and premature death, should take place in all communities of men; and the result has been the deduction of most important laws, having reference to the conditions necessary for health. Amongst other things they have found, as an invariable concomitant of an ill-drained district with damp houses, that the population is unusually unhealthy; the animal system becomes relaxed, and the spirits despondent, whilst the children are degenerate, and not unfrequently deformed; that even the principle of moral rectitude is lowered; in short, that dirt, discomfort, misery, and crime, are invariably resident in such localities.

It is not singular that, under such circumstances, the engineer is a more practical and efficient missionary than the divine, for it invariably follows, that by removing the cause, a marked improvement takes place in the tone, morals, and health of the residents in such districts. These are facts which have been corroborated time after time by the police

and parish authorities, whose duties require their attendance at such places.

Dr. Southwood Smith, in one of his reports, says, "It is remarkable that the districts of which we have been speaking, are not only the seats of disease, but the great seats of crime." Captain Miller, when Police Superintendent of Glasgow, in a report on the state of crime in the above city, says, "It is of great moment, as affecting the state of crime, that the health of the town classes of the community should be attended to." Further on he describes one portion of the city as follows: "There is concentrated everything that is wretched, dissolute, loathsome, and pestilential. The places are filled by a population of many thousands of miserable creatures. The houses in which they live are unfit even for styes, and every apartment is filled with a promiscuous crowd of men, women, and children, all in the most revolting state of filth and squalor. In many of the houses there is scarcely any ventilation; dunghills lie in the vicinity of the dwellings; and from the extremely defective sewerage, filth of every kind constantly accumulates. In these horrid dens the most abandoned characters of the city are collected, and from thence they nightly issue to disseminate disease, and to pour upon the town every species of crime and abomination." Further on he remarks: "Much might be done to relieve the misery, and to repress the crime, of this destitute population, by compelling attention to personal cleanliness, so as to remove and prevent disease, by placing the lodging-houses for the destitute under proper regulations; by preventing the assembling of a large number of persons in one apartment; by opening up and widening the thoroughfares, and forming new streets wherever practicable; by causing the houses to be properly ventilated, and all external nuisances removed; and by an improved plan of sewerage for carrying away all impurities. Were it possible to adopt measures something similar to these, the health of the community would be greatly improved; and by the breaking up of the haunts of vagrancy, a happy check would be given to the spread of profligacy and crime." In the same report a Mr. Davis says: "I have no hesitation, speaking from ten years' experience of the poorer classes, in affirming, that there is a most decided direct connection between confined districts, bad sanitary arrangements, and poverty and vice." One other quotation—The Rev. Mr. Fearron, of All Saints, London, says: "I think I have observed moral improvements in particular

families in a very short time when means of additional cleanliness have been given to them. Their self respect has been increased. In very unfavourable localities I think I have seen the people striving against filth. Those were persons of well constituted minds, who revolt at the condition of the neighbourhood, whilst others sink down into a state of apathy and indifference. The wish of the people for improvement has been sufficiently shown by their thankfulness for the recent exertions of the town authorities acting under the 'Nuisances Removal Act.'

In a Report by Mr. Robert Rawlinson on Dorchester, in 1852, he quotes the following description of a portion of the town as existent in 1848. "In Higher Fordington, from want of the means of cleanliness, typhus fever has never been absent for the last three years; and in Lower Fordington there is a crowded and pauper population dwelling in the midst of filth.

"There is no underground drainage in any street.

"There is no water brought to any of the houses, and very many have neither pumps nor wells.

"In Back South Street the water stands after rain several inches deep, leaving a residuum of mud most offensive; and the back streets in general are so ill paved, that the refuse collects and festers between the stones: many yards have no form of pavement.

"Few of even the better class of houses have water-closets: many cottages have no privy accommodation: others have a privy close against the house wall, or under the roof, and the foul refuse soaks through the wall and floor. In these houses typhus fever is rarely absent.

"The churchyards are in a most disgusting condition: St. Peter's churchyard is saturated with human flesh."

With the exception of the churchyards, this description would even now fitly apply to many portions of Melbourne and Collingwood. In proof of which I beg to submit the following letters from Dr. Richard Tracy and Dr. Thomas Embling, both gentlemen having a large experience and practice in Collingwood:—

T. Rawlinson, Esq.

Sir,

I should be happy to tender you any assistance in reference to the sanitary condition of East Collingwood, Fitzroy Ward, &c.; but really the chief *epidemic*, since the great inrush of people three years ago, has been of that promising character, the "Epidemy of Reproduction." I have remarked the free-

dom of the "Flat" from many of the maladies resulting from "hot winds," and greater healthiness there to that on the "slopes" and the crown of the "hills," owing, I believe, to the tremendous aridity of the hot blasts. Strange to say, even the dankest lanes and "little streets" have had great freedom from epidemics; and diseases here appear to laugh at the grave assertions common in "cloud and mist land." In short, excepting the horrible curse of drink, the sufferers from coup-de-soleil, and the usual hydrocephaloid cases, I will match Collingwood against any civic or suburban locality of the colony.

There have been many cases of jaundice, of bilious fever, of typhoid maladies, &c. &c.; but none so local as to denote speciality of origin, or peculiarity of local mischief. I have formed this opinion, that until Collingwood becomes well soaked with filth, by length of occupation, so long will it be healthy; and that if the City and East Collingwood Corporations only do us justice, and compel clean cesspools, and good roads, with fair drainage, Collingwood will remain permanently (other things being equal) a very healthy spot; and that this we must ascribe to the good Providence which directs the scavenger blasts direct from the great Sahara, to dry up and destroy all surface, and even deeper moisture, every summer.

I am, Sir,
Your obedient Servant,

Gore-street, June 5, 1856. THOMAS EMBLING.

139, Brunswick Street,
9th June, 1856.

Dear Sir,

I beg to acknowledge receipt of yours, dated 5th inst. I am sorry that I have not had time to answer it more speedily.

I have now been nearly four years practising in Collingwood, and during that period the statistics of disease, and the rates of mortality have varied very considerably. During the years 1852-3-4 disease was rife, and the proportion of fatal results large, particularly amongst infants. A gradual improvement has taken place during the last twelve months, and the health of the locality will now bear comparison with any other portion of this city. The cause of this is easy of explanation. During the first period referred to, hundreds of newly arrived immigrants selected Collingwood as the place of temporary abode every week. Tenements of a miserable kind were hastily erected for their reception, and families were crowded into the smallest possible space. I need not impress upon you how very susceptible those people were to the diseases peculiar to the colony—the overcrowding, as a natural result, causing the type of fever, now so well known by the name of "Colonial Fever," and the improper food causing dysentery. The food principally consisted of meat; vegetables were not to be had, except at fabulous prices. Milk was exceedingly scarce, and dear. This last want soon told on the infants, the animal food irritating the intestines, and soon causing dysentery.

There was also an amount of mental depression about our patients at that time that lessened their chances of recovery very much. Many of them had never known anxieties or toil before; their hopes had been great, and the reaction on finding everything so different from the comforts of an old country, was in proportion severe. All these causes will, to a great extent, account for the large amount of disease that existed for some considerable time after the gold discovery. Let us now glance at the present state of the district, and see what are the chief preventible causes of disease. The population is not now nearly so dense as it was. Some of the worst dwellings have been removed; but in the cottage residences there is still much room for improvement. Vegetable and dairy produce are now abundant, and to this much of the improved state of the public health is to be ascribed.

"Collingwood Flat" is of course, in its present undrained state, an unfit place to build on; but, strange to say, there has not been the great disproportion between the health of those living there and those on the hill that might have been expected. The very worst cases of fever that I have known in Collingwood were on the highest parts, where houses were crowded together. Habitations on the Flat were *scattered, and in this was their safety.* If I were asked what is the chief generating cause of disease now? I should say the wretchedly small allotments on which the houses have been built in the blocks between Smith and Wellington Streets. The yards are most miserable; in many cases occupied by stabling; and the temporary, inefficient manner in which the cesspools were sunk, allows the soil to penetrate the ground, and proves a fertile cause of disease. One of the worst of those streets is Little Oxford-street, and I am pretty sure it has been the most unhealthy street in Collingwood. Fever has been very fatal in it, and several families under my care were constantly ill, until I succeeded in persuading them to leave the locality.

Another evil is the way in which the water for domestic purposes is kept in impure open casks. The casks are rarely, if ever, cleansed.

I am quite sure that the chief cause I have above alluded to (insufficient space) is, and will continue to cause, fever among us. It is a rather difficult thing to rectify, as it interferes with the rights of private property; but if public attention be called to it, the houses will not let, and landlords will be compelled to alter the style of dwelling and size of allotment. I could name several freeholders who have within the last year left their property in that locality, at great pecuniary loss, but with much benefit to their health. Another removable evil is the slaughtering of sheep and pigs, in connection with the various butchers' shops. Previous to the opening up of Napier-street in Fitzroy Ward, there were two large establishments of this kind in that locality, and I have notes of many bad cases of fever of a typhoid type, which occurred close by. A marked improvement has taken place since their removal. This practice should not be allowed at all in such close undrained places.

There are many other things which might be mentioned, but as I am not much accustomed to writing reports, I shall be glad, if you think I can afford you any further information upon this subject, to see you at my house any evening, to converse the matter over.

Believe me,

Yours, &c.

RICHD. THOS. TRACY, M. D.

T. E. Rawlinson, Esq.

In addition to the statements set forth in his letter, Dr. Tracy expressed himself to me very strongly in reference to the practice that has hitherto been followed of crowding on small patches of land a number of ill-constructed, ill-ventilated tenements, without regard to drainage or other consideration for health; the result of which is, that such places are the fruitful sources of sickness and fever; the only real cure for which is a removal to better situated premises. Many of these evils would be obviated by an immediate application of the Building Act to East Collingwood.

As one familiar illustration of the annual loss by disease from preventible causes, it may be stated here that in wealthy, civilized England, in the year 1851, the deaths from typhus

alone was double the number killed in the allied armies at Waterloo.

In the report on Dorchester, before alluded to, the Rev. H. Moule shows the evils arising from want of drainage in a portion of the district, as follows:—"There is no system of drainage, but the slops and refuse are thrown out before the cottages to be carried away as well as they can; the privies are in a most disgusting state; generally the supply of water is from wells, one attached to each row of cottages. From such a state of things, as may well be supposed, fever, typhus and scarlet, is continually prevailing. The houses perhaps the most objectionable, are those inhabited by Widow Bullen, Widow Holland, Martha Hussett, and Mrs. Cothin. In the first, the drain runs through the passage, and empties itself into the road: this house is hardly ever free from fever. In the second, the back garden is considerably above the level of the floor of the house, and the privy in one corner of the room; here the owner died very lately of fever. In the third, the privy is immediately under the window, the wall of the house forming one side. In the fourth, there is a gutter opposite, which receives all the refuse of the cottages situated above, and has no vent for the accumulations: here the whole family have just had the fever, and one child died of it."

The preceding quotations are given as illustrative of the more general statements I have already made in this paper relative to the intimate connection between filth and disease, foulness in house and person, and crime. Further and more intimate perusal of the sanitary reports which have been issued from time to time under the sanction of the English General Board of Health, also shows, that not only does a vast amount of preventible disease exist, but likewise associated crime, and that any cause which tends either to aggravate or remedy the one, affects the other. This has been so satisfactorily proved, that it may be safely asserted that "the cost of sanitary measures is a saving to the individual and to the community." Paradoxical as this may sound, it is not the less true; for by removing disease, we increase our available amount of reproductive labour; and by lessening crime we not only increase reproductive labour by reforming the criminal, but lessen the charges which are now incurred for a numerous constabulary; whilst for each member of the community, more economy of means, and a greater amount of happiness is secured, owing to freedom from loss of time and money by sickness, a constitution weakened

by suffering contingent on the latter, and expensive bills for medicine and attendance.

A careful consideration of the preceding statements, and a comparison of the condition of many portions of our town districts, with those reported upon by the Superintending Inspectors of the English General Board of Health, will, I think, be sufficient to satisfy any impartial inquirer, that we are rapidly accumulating around us in Melbourne the hotbeds of pestilence and fever in our undrained courts, yards, rights-of-way, and neglected privies, from the latter of which the night soil often overflows the surface of the adjacent land, commingling with the kitchen waste and refuse of all kinds, both organic and inorganic.

Although our extraordinarily dry climate, the present scanty supply of water for domestic purposes, limited population, and comparatively large powers of absorption in a new soil, conjointly, may save us for a time from the consequences of our imprudent neglect, we must not hope long to escape with impunity the certain consequences that follow any violation of the necessary conditions of health.

Neither must we forget that year by year the population of Melbourne is becoming more concentrated; the soil more and more saturated; and that in the course of another twelve months we shall have an abundant water supply in the town: the necessary result of which will be, that much more water will be used for household purposes than at present, and the waste thus created must, from the want of sewers, be turned either into the open street channels, or into the yards and rights-of-way, to evaporate in steaming pestilence, or be concentrated in a still worse form in some old cask or cesspool sunk in the ground. In this manner, the refuse and garbage which, under our present deficient supply of water, becomes rapidly desicated and comparatively harmless, will, when continually saturated, and acted upon by our burning summer sun, rapidly decompose and pollute the air with noxious and deadly gases.

This is no new doctrine, but a result that is certain and well known; and I have no hesitation in saying that under our present imperfect sanitary system, and total absence of sewers, the Yan Yean water supply will be a curse to Melbourne, instead of a blessing, and must continue so, until the city is sewered in a proper manner. I beg to impress this view of the question most strongly upon the members of this Society, and to urge upon them the immense importance, in a tropical climate such as that of Mel-

bourne, the extreme necessity which exists, for using every available means to have proper measures initiated and carried out to remedy the present deficient arrangements. I beg, also, in this place, to record my total dissent from an opinion given a few months back by one of our public Boards, that we can either afford to delay the question of sewerage, or that we cannot afford the cost. I also differ most decidedly from the same authorities, when they infer that engineering science is not at present sufficiently advanced to deal with such questions, for notwithstanding the difference of opinion which has existed, or may even still exist, in England as to the best materials and mode of working, I aver most distinctly that the subject of drainage has been met and treated in a most successful manner in the English towns wherever the Health Act has been applied and fairly carried out. This question of sewerage is a most serious one, and great is the responsibility of those who, by unnecessary delay, may be accessory to bringing upon us the fearful consequences attendant upon want of suitable sanitary works.

Not the least of the evils arising from the want of proper drains, is the continual saturation of the ground with moisture and filth in all its varied forms, from which cause dwelling-houses soon become damp and exceedingly unhealthy. Receptacles are also required for receiving the garbage and refuse which, in conjunction with the cesspools and privies, form a fruitful source of annoyance and sickness.

The opinion of the Board of Health Inspectors with respect to the danger arising from either cesspools or open privies, is so very decided, that they roundly assert, as the result of their experience, that such receptacles are more dangerous to health, owing to their concentrated power, than if the same contents were allowed to spread over the land, as it is formed; for in the latter case, although a greater nuisance for the time, it would soon become bleached in the sun and rain; whereas in the Cesspool it continues to ferment with dangerous activity. It is a dogma with these officers, that "where there are no sewers there can be no effective house drains;" and to this I beg to add, that *where there are no efficient house drains, there must always exist a strong predisposing cause for the production of debility, sickness, and death.*

Already in Victoria have we suffered seriously by sickness brought on by inattention to the mode and manner of living.

It will be in the recollection of most here how large an

amount of sickness and mortality existed in and about Melbourne in 1852 and 1853; and still more recently the great outcry of destitution in Collingwood. During the past year we have had sorrowful evidence of the mortality in and around Melbourne, from the numerous females that are to be seen in deep mourning for some near relative or friend prematurely cut off in the prime of life, if the burial records are to be taken as a guide.

In Archer's "Statistical Register for Victoria," I deduce the mortality from the table of deaths registered in Melbourne and the suburbs, between July the 1st and September the 30th, 1853, as follows:—

116 males died under 5 years of age.
252 ditto died being 5 years of age, and upwards.
117 females died under 5 years of age.
140 ditto died being 5 years of age, and upwards.

In an appended note Mr. Archer remarks, that amongst the males above five years of age 26.58 per cent. of the deaths were from zymotic or epidemic diseases; whilst the same class of disease amongst the females above five years of age was 30 per cent.

For the year ending the 30th July, 1854, it appears that amongst the males of all ages out of every hundred throughout the whole colony, there was not less than 39.76, or nearly 40 per cent., who perished from zymotic, that is, endemic, epidemic, and contagious disease; whilst the destruction of female life from the same causes was 44·79, or nearly 45 per cent.

This is in striking contrast with the proportion which perish in England and Wales from such causes, for there the deaths from zymotic diseases average but little above 20 per cent of the total deaths from all causes. An attentive perusal of the returns of the Registrar-General will show that the chief agents in this destruction are dysentery and diarrhœa.

In a conversation with Mr. Archer on this subject, he remarked to me the striking equality which at present exists in the proportion of deaths from all causes in the crowded metropolis and in the country districts.

In perusing the above statements, it must not be forgotten that this large per centage of deaths is from preventible diseases alone, from amongst a population of young and middle-aged persons, at a period when life is justly considered to be in its prime.

I have been wholly unable to institute a satisfactory com-

parison of the proportion of deaths to the whole population up to the present time, owing partly to my not having been able to procure the necessary returns, but still more to the migratory character of the population in and around Melbourne especially.

The only approximation which I have been able to make is for the year ending 30th June, 1853, which shows 20 deaths in 1,000 of the population. In England, 24 in the 1,000 is considered so very excessive, that it is generally followed by a visit from one of the Inspectors of the General Board of Health. Although it would have been very desirable to know with certainty the exact proportion of deaths to the population, it is not of vital importance to the subject matter of the present paper; for I think we have sufficiently startling evidence of the great waste of human life here, in the extracts which have just been quoted.

It is to little purpose that the "let alone" apologists may urge that we are very healthy, and that we have little sickness and death; for if it can be shown, that out of our whole population, only two persons die annually, and that one of these two might have been saved by common attention and care, it will make little difference whether the neglect is national or individual, the death is equally murder, if the individual is allowed to perish from causes which we have neglected to remove; for, an indifference to such facts as those I have just pointed out is, indeed, sinning against light and knowledge. The remarks relative to the equality of proportion between the town and country districts, although it may appear, at first sight, to bear against the arguments I have used relative to the unhealthiness of towns, &c., it does not, after mature consideration of all the facts of the case, bear out such a view; for it must be remembered that we are now in a transition state only, as our towns have not had time to develop the malignant nature of the filth and refuse with which the land is becoming gradually soaked. The equality may continue to exist for a time, but it cannot last; for as like causes produce like results, all other things being equal, so surely will any flagrant breaches of sanitary laws bring their own punishment.

The excessive nature of this preventible mortality in Melbourne and the country generally will be seen more clearly by comparing it with England, where the population is composed of the old, the sick, and the feeble, amongst whom we naturally expect a large mortality; whilst, in Victoria, our

population is composed of the young, hale, and strong men and women, amongst whom vitality ought to be in its greatest vigour. In addition to this, we have all the advantages of a mild, dry climate, fine wide streets, with park reserves at frequent intervals, the town lands generally being but thinly built upon. Yet we approximate in numerical number of deaths to England.

As there must be some very strong generating cause for so large a mortality which is capable of neutralizing the many very favorable circumstances under which we live, we are necessitated to look around and seek for a solution of the question by comparing things as they exist here with the condition of other places that are known to us elsewhere. We know that here the amount of remuneration for labour, and comparatively low cost of food and raiment, enable the workman to live in a much superior manner to what he could have done in England; but when we learn that he resides in a damp, ill built, badly ventilated house, the nature of the secret begins to dawn upon us—for fatal experience has shown, that high wages are no boon, and high living no safeguard, if the habitation is defective, and the situation viciously bad, the certain result of such a state of things being, that the unfortunate resident suffers from want of rest and refreshment—debility and apathetic indifference follows, which generally leads to the private grog bottle or the public-house—the person becomes neglected, the family uncared for, disease enters, causing, in addition to loss of wages, extra expenses for attendance and medicine, the scene frequently closing in death from a preventible cause—the victim, in many cases, leaving behind a young widow and family unprovided for, and oftentimes sickly from the same causes which destroyed the husband.

From the unprecedented circumstances under which this colony was placed four years ago by the discovery of gold, and the consequent rapid increase and diffusion of wealth, not only among the higher classes, but amongst the mechanics and labouring sections of the community (the skilled mechanic obtaining from 20s. to 35s. per day, whilst the labourer received 12s. to 15s. per day, the price of provisions continuing at a moderate rate)—the charge for house-rent rose to an enormous sum, the rental varying from 20s. to 40s., and even upwards, per room per week, very frequently paying upwards of 100 per cent. per annum on the original outlay.

Under this state of things the want of additional house ac-

commodation was severely felt. This will be more fully understood when it is remembered that we were receiving additions to our overcrowded population at the rate of from 2,000 to 3,000 souls per week. It was at this time that we had the strange anomaly of Canvas Town and the Sandridge Tents, in which places not less than 15,000 persons must have been located at one time, forming a population strangely compounded of the virtuous and the vicious, the learned and the illiterate, crowded together in the midst of sickness, filth, privation, disease, misery, and untimely death. Our old Cemetery bears many memorials of this time in the names of the numerous dead (struck down in the prime of life), and also the remains of many more who passed away from amongst us, uncared for and unknown! Low fever and the exhausting dysentery or diarrhœa, brought on by the total change in their habits of life, and by perhaps the most common cause of all, their lying down to rest upon the bare ground, exposed to any trace of miasma, noxious gas, or damp which is generally found resting upon the surface of the ground, or emanating from the same, more especially during the night time. Though the traces of such deleterious agencies may be but faint, still they are capable of acting with accelerated energy upon the bodies of the unfortunate victims who remain exposed to their influence after a day of toil, perhaps enervated and worn down by disheartening journies in search of employment, under a burning sun: in addition to this, the whole system being relaxed during the hours of sleep, the body is rendered still more susceptible to the action of such subtle poisons, which, though imperceptible to the external senses, act with not the less certain, though perhaps slow, results upon it.

At the period now alluded to, the house accommodation of Melbourne, although infinitely superior, in point of comfort, to the tents, for those who could afford the expense, was miserable in the extreme, the victuals being generally ill cooked, and worse served, at a general table, where clean hands or a washed face were not considered essential to secure admission: the sleeping accommodation being provided on the same economical principle as adopted in packing a layer of herrings in a barrel—it was literally "shoulder to shoulder," in close unventilated apartments, the cubical area of which was utterly disproportioned to the number of occupants, and, as a natural consequence, the effluvia arising from the breath and bodies of so many human beings, in a confined

chamber, during sleep, soon became sickening: to this cause must be ascribed much of the sickness and mortality in the town.

At such a state of things as that narrated above, it will be readily conceived that all right feeling minds would revolt, and look forward with anxiety for some mode of escape from the semi-savage abominations with which they were surrounded, by a removal to some locality where even a wooden shed, if it were on a piece of land of their own, would be a great improvement on the then existing order of things, because such a place could be extended and gradually added to in leisure hours.

The evil arising from the want of proper dwellings being so universal, it was rapidly met by two kinds of accommodation—the first, that afforded by persons who had land for sale in the vicinity of the city having it subdivided into small allotments and sold by auction; and the second, by associations amongst the people (under the sanction of a few respectable names) in Building and Investment Societies, where, on the principle of a moderate monthly payment, members had an opportunity of borrowing money on mortgage for building purposes.

By these means very large sums were rapidly invested in land and buildings on every available piece of ground, whether suitable for residence or not. It was under the influence of these circumstances that so much of the Collingwood and Richmond swamps became tenanted; for so great had the mania for land become in 1853, that an auctioneer merely required to announce some land for sale, with a brilliantly colored plan, showing fine streets, &c., &c., to attract a crowd of purchasers for the several allotments shown—almost fabulous rates being realized. Many persons made a business of buying several allotments at such rates, and of again subdividing them for sale, by this means still further complicating the plans, but yet realizing large profits on such transactions.

At this time the choice of locality was limited to a confined district, which, for the most part, was not of the most favorable character for dwellings; and unfortunately, in many instances, private holders not hampering themselves with strict rules of business, and, I regret to add, with not over-correct ideas of propriety or justice in either selling or conveyancing, they could, with much greater facility, bring their land under the hammer for sale than the

Government, however diligently or conscientiously active the official routine was carried through, for the purpose of rendering more suitable land available for building purposes. That much of this delay may have arisen from faults inherent in the present system of managing public lands, and susceptible of amendment, is a point open to fair discussion, but the consideration of which does not come within the province or scope of this paper, it being sufficient for the present purpose to point out briefly some of the causes which have led to the settlement of localities so unfavourable for health, in place of those higher portions from which the drainage falls naturally.

It is with the view of urging the claims of such districts upon the country generally, for assistance in remedying the defects of situation, as above pointed out, that the above remarks are written; for, unfortunately, so many persons are now involved, and those generally of a class least able to look to their true interests, in enforcing and carrying out the requisite sanitary works, owing to their humble condition of life, the land being generally divided into a large number of small holdings, it necessarily follows that Government aid is required to enable local management, under suitable control, to remedy the evils which have arisen, or may arise, from the past irregular and ill considered arrangements, which has arisen under the influence of a most unprecedented state of things, and which, perhaps, has never before existed in civilized society, if we except our contemporaries of California.

Much has already been indicated in the right direction in and about Melbourne to remedy the above evils, and also in reference more especially to sanitary matters; but much still remains to be done. Although we have, for instance, the Streets and Alleys Act, the Building Act, the Lodging House Act, the Nuisance Removal or Management of Towns Act, a Water and Sewerage Commission, and also a Board of Health, &c., &c., in operation, or some modification of the same, in a greater or less degree, their efficiency is not such as we have a right to expect. It should be distinctly borne in mind, that the value of one and all of the above Acts and Commissions is entirely contingent upon the carrying out of the same in their integrity, not in the mere letter, but the spirit of each Act.

Before pointing out any remedial measures for Collingwood, I shall endeavour to give a brief general description of the physical character of the district.

The portion of Collingwood usually alluded to and known as the Swamp or "Flat," is a tract of land lying a little to the north of East, and one and a half miles distant from the Melbourne Post Office. The Flat has an elevation of about 60 feet above the Yarra Yarra at Princes Bridge, and forms the bottom of an irregular basin, open to the River Yarra Yarra on its eastern side. The Richmond hill may be considered its southern boundary; and from this the line of water shed passes in a curved line, bearing about north-west across the south-west corner of Fitzroy Ward, and on in a tolerably regular line a little wide of the north-eastern angle of Dr. McKay's Church, and also a little wide of the north-eastern angle of the University enclosure; thence northerly by way of the Cemetery, past the Brunswick Quarries, to a ridge of land intervening between the Quarries and the Merri Creek; from this point it runs easterly along the ridge to near the Northcote Arms Hotel, and thence by a curved line winding south-easterly to Dight's Paddock, through which it passes, and terminates near Johnston Street. A considerable spur from the general line of water shed passes under the south end of Brunswick Street traversing the basin described in a north-east direction, passing under Napier Street, George Street, and Gore Street, crossing Smith Street at its intersection with Johnston Street, and terminating in Budd Street.

The flat and northern portion of the basin is coated with an impervious marly loam, and thickly studded with bluestone boulders—indicative of the basalt which lies immediately below the surface. The remaining portion of the district has no peculiar character to call for remark other than its freedom from the basalt which strews the northern side and the flat so thickly.

The rain-water that at present falls within the area just described (about three square miles) finds its outlet at present by means of a ravine on the eastern side of the Flat, known as the Rocky Gully.

There have been several surveys and reports made upon this locality by order of the Government, having a special reference to its drainage; but the only result I can learn of which has arisen from them, is a ditch for collecting and conducting the flood waters into the Rocky Gully, and the formation and metalling of Johnston Street, Wellington Street, and Simpson's Road.

Mr. Clement Hodgkinson, who has devoted much time and

talent to the solution of the drainage question in reference to Collingwood, has, I believe, in conjunction with Mr. M. P. Smith, the city surveyor, recommended an open cut along the north side of Reilly Street to the river Yarra Yarra; which, in conjunction with the drain down Nicholson Street, is intended to relieve the Flat from at least two-thirds of the rain-fall which at present passes through or over it. In addition to the above, I believe Mr. Hodgkinson has recommended that Great Gipps Street should be cut down to allow a direct drainage into the rocky gully from the lower portion of the Flat.

The recommendation of open ditches, as given in outline above, will answer very well for the present as a temporary measure, for avoiding some of the greater evils of flooding, which are at present suffered by the residents on the low ground; but such open drains to continue efficient, should be deep, with flat slopes, of not less than 1 to 1; the bottom narrow, and pitched with stone in places where clay or marl exists, to protect it from being scoured into holes, and irregularities; such holes being apt to harbour filth and foul corrupting matter, to the great detriment of the neighbourhood. In addition to the above, such open drains ought in all cases to be securely fenced, not only for the prevention of accidents, but also to keep out cattle. Suitable bridges should be built across the drains, to accommodate the street traffic where such is of importance.

As (with the exception of a very slight portion at its south-west angle), the whole of Fitzroy Ward district has a decided inclination down to the Collingwood Flat, it is necessary to consider the area and requirements of the ward in connection with any measure for the drainage of East Collingwood, and where not specially excepted, this must be understood.

The portion of the swamp south of Simpson's Road being within the Richmond district, and having sufficient drainage facilities within the Richmond boundaries, I have not taken it into consideration, although a large portion of the low lands, north and south of Simpson's Road, may with advantage be drained by a joint sewer down the centre of the said road.

The first measure necessary to be done for effectually draining Collingwood, is the opening up a new street, of not less than one chain wide, through the at present uninhabited, and uninhabitable portion of the flat, now occupied by the catch-water drain between Johnson Street and Great Gipps Street.

This proposed new street, which I shall call the "Low Level" street, should be formed sufficiently low to receive the drainage into its water-tables from all the adjoining land, care being taken to give it a good inclination down to Great Gipps Street. This latter street should also be new formed, in order to drain the adjoining lands, with a regular gradient down to the rocky gully, from the junction of the Low Level street; but this will not be an absolute necessity, if the after suggestions be carried out.

The streets which run north and south, such as Wellington, Cambridge, Oxford Streets, &c., should be formed with such gradients, that their surface and drainage waters could be conducted by the shortest route into Great Gipps Street; and those portions of such streets which are divided from Great Gipps Street by the high ground at the north end, ought to be formed with a view to their waters being passed direct into the Wellington or Low Level streets by means of the cross streets running east and west. All the streets lying east of the Low Level street, should have their gradients laid down with special reference to such street, from the summit of the low ridge in this portion of the Flat; but on the eastern side of the ridge the gradient should be laid (in so far as it is possible to do so without incurring serious expense), with a special reference to Great Gipps Street. The whole of the above streets should be cut down sufficiently low to provide ready means of drainage for the adjoining lands.

The streets through the low land north of Johnston Street should be all formed by embanking, and it should be imperative on every person building to such streets, to fill up, and around his premises sufficiently to secure good drainage to the street, before he is suffered either to occupy, let or rent any buildings in such embanked streets.

I may also observe in this place that it should be rendered compulsory on all land or house owners having a frontage to made streets, to form and pave the footpaths and channels in front of their respective premises; for until such is done, it is scarcely possible to keep the roads passable, owing to the formation of mud in the winter, and of fine pulverised dust during the summer, both of which are created very largely on our unpaved footpaths: in addition to which the channels, when left unpaved, become the depositaries of the fetid mud and filth of the locality, which no reasonable amount of scavenging can keep down, or effectually remove.

For the permanent sewerage of this district, there should be two main sewers; one passing down Johnston Street to the

river Yarra Yarra, of sufficient capacity to carry off the sewerage and flood waters of the lands lying between it and Reilly Street, and all that portion of the district lying on the south side, which can be conveniently drained into it. It may also be used as the receiving sewer for Fitzroy Ward for the present.

A main sewer should likewise be constructed down Great Gipps Street, commencing at a minimum of size in Wellington Street, and increasing to its maximum size opposite the Low Level street; from whence it should be continued to the rocky gully: the sewerage to be there treated as will be afterwards described.

Subordinate sewers would likewise be required along the Low Level street, and along the greater portion of Wellington Street and Stanley Street, Peel Street and Derby Street. The whole of the above sewers should be of sufficient capacity to pass the sewerage and storm waters. As they would be the receiving sewers for a large district, they should be constructed of English brick or dressed blue stone; the lower half being laid in Roman cement, and the upper portion in hydraulic lime, the top being covered with a coat of good clay puddle.

Cast iron mains might be used with advantage in some of the other leading thoroughfares, where a large sectional area is required; but in all cases where 15 inches diameter, and under, will suffice, stone ware pipes are admirably adapted for the purpose.

Whether in the main or subsidiary sewers, it is of the utmost importance that curved junctions, easy gradients, and the best workmanship, in laying and jointing, be secured; and also that ample means for ventilation and inspection be provided.

All trapping should be done by syphon pipes, in preference to any mechanical contrivances, which being very liable to get out of order, form a continual source of stoppage and annoyance.

The large stream of sewerage waters that will be passed through the Great Gipps Street sewer into the rocky gully, can, with great advantage, be collected in a series of depositing tanks, and treated with powerful deodorisers, for the double purpose of preventing noxious emanations from the sewerage, and also for the precipitation of the solid matter held in suspension or combination by the sewerage waters.

If this operation is conducted with ordinary skill, the sewerage water may be passed away into the river, apparently

perfectly pure and pellucid, whilst the residuum left in the tanks, when collected and dried, will form one of the most powerful manures known.

So perfect is the deodorising process in the suppression of all offensive odours, when carefully applied, that a portion of such prepared guano has been passed round amongst the guests at a scientific soirée, without a suspicion arising as to the nature of the powder submitted to their notice.

In evidence given before a committee of the British House of Parliament on the subject of sewerage manures, it is there stated, in the broadest terms, that works can be erected on the site proposed (nearly the centre of Westminster), for receiving the liquid sewerage of Westminster, and precipitating and deodorising the solids held by it in suspension, without nuisance to the neighbourhood. After a severe examination of the chemist of the company, all that could be elicited was the possibility of at times a slight odour existing within the area of the deodorising chambers; but even that would be removed by flues provided for the purpose.

By a suitable arrangement of settling tanks and apparatus along the rocky gully, the whole of the sewerage passing down Great Gipps Street sewer may be treated as above described, and form a valuable source of revenue, in return for the outlay for apparatus and sewers. The amount of sewerage from Collingwood and Richmond would not be sufficient in volume to perceptibly affect the water of the river Yarra Yarra for the present, even if not purified; but it must not be forgotten, that as population increases, and other towns spring into existence along the river banks, the amount of offensive matter that will daily find its way into the river, in the course of only a few years, will be considerable; for although each stream taken singly may be of little consequence, in comparison with the bulk of the river waters, the large number of small streams will operate nearly as effectually in ultimately saturating its waters, and forming deposits of fetid mud along its sides (more especially below Melbourne, where the tidal waters occasion alternate immersion and exposure of its banks) as a like volume in a more concentrated stream.

It is with the view of anticipating this great prospective evil, that I have more especially called attention to the system of deodorising and precipitating all sewerage matters before allowing their waters to pass into any of our running streams and water courses, and I beg most strongly to im-

press upon the members of this Society, the great importance of such operations, whether viewed as a sanitary question only, or of wise, self-remunerative economy.

The sewerage passing down Johnston Street, could be passed into the Rocky Gully depositing tanks, by a special sewer, if deemed desirable.

A general receiving sewer to pass the whole of the district sewerage either by the river banks or by tunnelling through the high land of Melbourne to Batman's Swamp, to deal with it there either by precipitation or by the discharge of the whole sewerage direct into the river has, I believe, been suggested. The expense of constructing such a sewer would of necessity be enormous, and very much in excess of the cost for executing the necessary works in Collingwood Proper for disinfection;—in addition to which, in the latter case, the expenditure would, to a certain extent, be reproductive, whereas in the former it would be wholly unproductive, and entail, in addition to its first cost, a large annual outlay to keep it in order and repair.

If such an intercepting sewer were constructed for the sewerage only, it would be necessary to provide a second system of drains for the storm waters. But if calculated to pass the storm waters, in addition to the sewerage, it must be constructed of an enormous size, and at a proportionately large expense. I have no hesitation in asserting that any such sewer would be very imperfect in its operation; that during a large portion of its course it would of necessity become a sewer of deposit; and that no reasonable pumping apparatus would suffice for draining its foul corrupting waters.

In any arrangement for dealing with the sewerage manure as recommended, there would be required a simple self-acting system of sluices and gates, by means of which, in times of flood, the large extraneous body of surface water passing through the main sewers, would be discharged direct into the river, without passing through the depositing tanks, unless it were deemed advisable to do so for scouring or other purposes.

For the perfect action of any system of sewerage, there should be a full and ample water supply, without which the house drains are liable to become choked.

A fruitful source of stoppage in drains arises from imperfect arrangements for the admission of the surface water, which allows the passage of the debris of macadamised roads into the sewer; and in the absence of a sufficient fall and scouring current for passing the same, it becomes deposited in a dense, hard stratum along the sewer bottom.

In addition to a complete reticulation of water and sewerage piping through and amongst the town dwellings, it is of equal importance that a strict and thorough surveillance should be kept over the streets, rights-of-way, and yards, to prevent any nuisance arising from the carrying on of any trade or business of a noxious character in the vicinity of dwelling-houses, and also to protect the citizens from the evil consequences of foul and dirty premises, whether such may arise from the filthy habits of isolated families, or the propensity of many to convert a small back yard into a species of zoological department for the retention of horses, dogs, goats, ducks, fowls, and the consequent abominations in a confined space of ground. Many offenders will profess to consider their liberties infringed by such inspection, and will consequently make a great outcry about the rights of property, &c., &c.—forgetting that property has its duties as well as its rights; and also forgetting that liberty is never perfectly free. It will be in the recollection of most, that a few years back there was no objection raised to the taste of London Aldermen for the civic effluvium arising from the foulness of Smithfield Market and gully grates; but there was a very strong objection to their continuance of such retorts, to the annoyance and injury of others not so directly interested in their conservatism as the London Corporation.

Trusting it may not be deemed irrelevant in this place, I shall obtrude a few general remarks on that fruitful source of cold, influenza, catarrh, &c., &c., in all countries—namely, damp houses.

Many persons in building will allow a hole to be excavated within the area of the building for the sake of a little loam. This ought not to be allowed, as it forms a reservoir for water to collect and putrify in. The trenches for the walls are also frequently cut down considerably wider than required, and the space left, instead of being carefully filled up and beaten down solid with earth, becomes filled up with broken brick or stone chips, that act as a reservoir for water against the foot of the wall, from whence it ascends by capillary attraction. To prevent this, care should be taken to have the trench cleared of broken materials and solidly filled up to the surface of the ground directly the foundations are laid in; and before the wall plates are bedded, the walls should be covered with at least a 3-4th inch layer of asphalte, or a double tier of Welsh roofing slate, bedded in cement throughout the entire thickness of the wall,

care being taken to cover all joints in the lower layer, by the slates of the upper layer. Either of these methods, if properly done, will effectually prevent damp walls from such a cause.

One of the most important agencies in any system of sanitary works is the establishment of Public Baths in the densest and poorest portions of the town, where, at a minimum of cost, hot and cold baths can be obtained at all hours. The means of thorough personal ablution is of much importance in a climate such as this. Having a strong opinion on this subject, I beg to submit that all public bodies having the control of the water supply, should be required by law to furnish the water required for public baths without charge—the expense being borne by the district at large in the shape of an increased water rate, if necessary.

It will, I am sure, prove to be sound policy to afford to the working classes a daily bath, with the usual conveniences of a bath room and attendance, at a less price than it costs them for a "*nobbler*" of brandy. By offering such a convenience at a low charge, many a tired exhausted man, would be tempted into the bath in lieu of the public-house; and I am quite satisfied that the first visit to a well-conducted establishment, would afford such superior gratification to what the public-house and its temporary stimulants can give, that the visit would be repeated, until the daily bath would become a habit and a necessary, to the great increase of the comfort and health of the frequenters. I need scarcely refer the members of this Society to the feeling of freshness, vigour, and elasticity, which pervades the body after a moderate use of the bath: the knowledge of such results will be the best argument in support of what I have just stated.

In judicious sanitary measures, we have the most powerful temperance pleaders, for they are truly preventives, and, as I have elsewhere shown, it is to little purpose that we preach purity of conduct, and the beauty of good morals, unless we precede the lecture by inculcating the absolute necessity of cleanliness in person, home, and locality; and by a few plain practical lessons teach the difference between the apathetic despondency of one system, and the exhilarating enjoyment of life in the other. To do this, it only requires that facilities should be given in suitable localities, and the classes to be benefited will not be long in availing themselves of such. We have a memorable example of this in the success of the public baths in London, at Charing Cross and Westminster, more especially, I may also allude to the Liverpool baths, as

very successful examples. No charge should be made for the use of a public bath beyond what is just sufficient to cover the interest of the original outlay, and the cost of superintendence, for the purpose of ascertaining the amount of revenue that each establishment could realise at a minimum rate of, say, threepence for a cold and sixpence for a hot bath; it would be wise economy to risk an additional outlay during the first year or two, until the institution could stand alone. So important do I conceive the establishment of cheap public baths, that I would make it one of the duties of the General Board of Health, to insist upon a due provision being made for such baths in all towns and villages throughout the country, in accordance with plans to be approved by the General Board of Health; the expense attendant on the erection of such baths, to be borne by the town funds, or by a special rate, if necessary.

Before concluding, I beg permission to recapitulate a few of the more important features which it is the object of sanitary works to remedy, and which I have endeavoured to set forth in this paper.

1st. The close and intimate relationship which exists between filth, discomfort, a polluted soil, and foul atmosphere, with crime, poverty, disease, and death—I may also add, in very many cases, political crime and riot.

2nd. That a physical purification of such dens of corruption and infamy, is an important step towards the moral purification of the residents.

That the poor are not the sole sufferers in the epidemics brought upon any city in consequence of the neglect of sanitary arrangements, but that such epidemics strike down the rich and the poor alike, is abundantly proved by the evidence given on such questions: hence the wealthy classes do not remain unscathed, whilst the poor outcasts are perishing in their ignorance and filth. An epidemic is not the calamity of a class (although it may originate with such), but involves all alike in its dire visitations.

3rd. That a comparison of the conditions of the undrained diseased districts in England, with some of our town districts, even at this early day, must satisfy the most sceptical that we are rapidly accumulating around us the seeds of pestilence in a saturated soil, and damp, crowded, ill-constructed houses, all of which evils are daily becoming worse.

That in the absence of sewers we "can have no efficient house drainage," and that, as a consequence, our increased water supply during the next year will render matters much

worse than at present, in consequence of the constant saturation and rapid decomposition thereby generated of organic substances, which now, thanks to our dry climate and *scarcity of water*, become rapidly dessicated and innoxious.

4th. That all noxious matters should be at once removed from the neighbourhood of our dwellings, by means of proper sewers and drains, before decomposition has taken place—that the solid matters contained therein should be converted into a marketable guano, whilst the fluid portion is run off into the natural water course.

5th. That, in the formation of new streets generally, the gradients and levels should be such, that all adjoining lands will be drained into them, instead of being retained upon the land by street embankments.

6th. That it should be compulsory upon all house-owners to form and flag the channels and foot-paths in front of their respective properties, and to flag and pave their yards with water-proof materials. It should also be incumbent on the owners of waste lands within the town area to fence in such, and pave the footpaths and channels in front of the same.

7th. That the Building Act ought at once to be applied to all town districts, in order to prevent undue crowding and the erection of buildings not suited for healthy occupation.

8th. That the establishment of baths in the poorest and most densely populated districts, at a minimum rate of charge, should be an imperative duty on each municipality.

9th. That, for the proper execution of each and all of these several works, the money required for the same should be raised by debenture (to be repaid in twenty-one years) bearing a moderate interest, and chargeable on the rates of the district.

The extent of the work executed being, to a certain extent proportioned to the present amount of rate, but capable of being extended with the increased value of property in the district.

This last clause contemplates the increased revenue that would naturally arise from an improved district, without the necessity of increasing the amount of the rate.

10th. That, for the purpose of making their debentures saleable in the English market, the Government should inform itself of the nature of the works contemplated, and, after approval of the same, it should endorse the debentures for them the same as for national loans, mortgaging the rate for interest.

11th. That stringent remedial measures should be taken in order to remedy the present Lodging House and other

sanitary Acts, where defective in their mode of operation. As an instance of the urgent necessity upon this point, I beg to call attention to the fearful condition of some of the hovels in Melbourne which pass under the name of lodging-houses, which places, I am informed, have complied with the letter, but defeated the spirit of the Act.

In company with Mr. Bowie, I visited one of these places last week, and witnessed a scene I little thought of as existing in Melbourne. After passing through two low rooms, used as a dining-room and sitting-room, we entered a narrow wet passage, with a row of dungeon-like cells on one side, about 4ft. 10in. by about 8ft. 6in., and about 6ft. 6in. high from the floor to the eaves; the door at one end about 2ft. wide, and the window about 2ft. by 1ft. 6in., the floor being on a level with a wet yard, saturated with slop and stable waste, whilst the walls were stained with grease, dirt, and damp. Opposite to these cells, which are used as sleeping-rooms, was another building used as a dormitory, and at the end of the cells a heap of stable dung. A little further on was another building used as a dormitory, with a loft above, which is at times also used for the same purpose. This is no fanciful picture, but a dismal reality in Melbourne at this time. For such places there is no cure but absolute annihilation; as I believe it to be utterly impossible that any amount of supervision or industry can render such rooms fit resting-places for humanity. It is from such dens as the one just described that the avenging pestilence will come, unless we adopt timely measures for rooting out such places from amongst us, and we must not forget that it is as imperative to prevent the re-formation of such places in other localities for the future, as it is to remedy the existing evils.

Finally. That, although the amount and exact nature of the influence, which sanitary works may have upon human life, has not been justly ascertained as yet, I think, the evidence adduced will show, to the complete satisfaction of all, that it has a most important and vital bearing upon the question; and, if viewed in no other light than as a moral agency, for increasing the sum total of human happiness and well-being, its great importance is as unquestionable as its influence is undoubted; for I must again repeat that filth, discomfort, misery, and crime, are closely allied, and that, by removing the sources of the one, we, in a large measure, reduce the other.

Lessen the sickness and mortality of a district, and we in-

crease our capital in the shape of available labour. Lessen the amount of crime, and we reduce our police rates.

Feeling deeply the vital importance of the subject with which I have attempted to deal, it is possible I may have been led into a strong expression of feeling at times on the various phases of the question, and by this means have given offence to some. To such I desire to express regret that it should be so, and beg of them to receive these remarks as offered—not in the light of a personal matter, but as an expression of opinion on a public question only, in which each good citizen is bound to act and speak according to the dictates of conscience, and that only.

I have to offer my sincere thanks and acknowledgments to Mr. Archer, the Acting Deputy-Registrar, for his courtesy in furnishing me with much valuable statistical information on the subjects treated of in this paper.

I have also to acknowledge the courtesy of Mr. Moody, the Town-Clerk for East Collingwood, in furnishing me with all the information I required.

ART. XI.—*On Motive Power in Victoria, economically considered.* By FREDERICK ACHESON, C. E.

IN having the honour of laying before the Philosophical Institute certain views on the subject of Motive Power in Victoria, I am impelled thereto, from the conviction of its immense importance to this colony generally, and more especially its bearing upon the development of the vast mineral wealth so lavishly bestowed thereon by the hand of Nature.

It must be admitted that the present exalted position and commercial prosperity of Great Britain substantially date from the successful application of steam as a motive power; the happy effect of that agent in giving an instantaneous stimulus and expansion to the various manufactures, and in creating new sources of industry, has been beneficially felt all over the world, and has accelerated the progress of England's prosperity to such an extent, as to mark the period of its introduction as a great era in her history.

But British manufactures thus suddenly swelled to gigantic proportions, demanded means of dissemination more in unison with their increased development: the same power, therefore, that reinvigorated them, in due course was adapted to pro-

pulsion on land and water, and thus railways and steam vessels became the handmaids of commerce.

If we find in England, where labour is comparatively cheap, the discovery of motive power by steam, followed by the most magnificent results in the creation of manufacturing industry and production of wealth, of what vital importance must the possession of an economical motive agent be in a new colony like Victoria? where labour is dear, and always will be, and the vast undeveloped resources of which present an industrial field for the skilled labour of millions of inhabitants.

But it is one thing to possess a country teeming with natural wealth, and quite another to become possessed of that wealth. Hitherto the colonial mineral resources have only been tested by unskilful manual labour on an isolated system, and by rude machinery, tantamount, as it were, to only scratching the surface. That under such unscientific mode of working and unfavourable circumstances, such surprising returns should have been obtained, as to render this colony the attraction of the whole world, only indicate the practicability of obtaining the most extraordinary results by the application of those principles and agents in manufactures which, in England, have wrought such astonishing success from infinitely poorer materials; in short, Victoria requires for the effectual development of her mineral and other resources, concentration and magnitude of working under recognised scientific principles.

It must be apparent that the principal element in the manufacture or conversion from raw material, must be motive power.

It is now high time that active steps should be taken to place the industrial pursuits of this colony upon a proper footing; excusable as it may have been hitherto under the peculiar circumstances, to leave the production of the staple commodity to the isolated and unskilful resources of private individuals, it now becomes the paramount duty of the "powers that be," to provide such facilities for the prosecution of individual pursuits by the masses of the people as in England are obtained on a large scale by the expenditure of capital.

That the Government have partially acknowledged the justice of this principle, appears from the fact of their having undertaken the construction of a system of railways which will probably cost £10,000,000 sterling: it may not, there-

fore, be altogether inconsistent, or imprudent, in the promoters of a costly scheme of internal communication, to make provision for the traffic by undertaking collateral schemes, tending to give such a successful impetus to industry, as shall draw a vastly increased population to our shores. This is all the more important, as it is impossible to suppose that the present population of 400,000 persons will afford anything like sufficient traffic to pay even working expenses, when the interest on railway construction alone will be half a million sterling per annum.

To carry out, therefore, the scheme of internal communication by railways successfully, it is quite as necessary to provide for the reproductiveness of the capital invested, by making arrangements for the creation of traffic, as it is to construct the lines of railway in the first instance.

It becomes then a vital question as to how the agricultural, mining, and other resources of this colony, can be economised in their development, so as to attain a magnitude and importance such as to render the expenditure upon a system of railways, only consistent with their eventual requirements.

From the fact of industrial pursuits having been hitherto carried on on an isolated system, and for the most part by dear manual labour, or other power expensively applied, it is not to be wondered that the cost of production is discouraging to enterprise, and materially retards the progress of the colony.

To remedy this state of things, it is absolutely necessary that steps be taken to provide cheap motive power on a large scale at the various centres of industry, which shall be available for the use of individuals engaged in various operative pursuits, especially the production of mineral wealth. With such facilities afforded, a vast field for industry will be thrown open to the masses of the people, whose only capital consists in activity, bone, and sinew.

If, for instance, in connection with every Bendigo in Victoria a vast motive agent existed, similar to the Yan Yean Reservoir, of enormous horse power, what immense industrial results such would produce when applied as a motive power in pulverizing quartz, washing auriferous earth, now utterly profitless, and at a fractional part of the existing cost, as I shall presently show? With such agents brought to bear, the hitherto difficult problem of economically developing our mineral wealth, would be immediately solved, and the present working expenses of our gold fields would be reduced to an inconsiderable item.

Agriculture would also receive a great impetus from the existence of an economical motive power being available for the conversion of its products into food.

Admitting, therefore, the vast benefits certain to accrue from the establishment of motive power on a large scale throughout the country, it yet becomes a most important consideration as to what extent such will be reproductive for the large amount of capital that must necessarily be invested therein; for experience has shown that great undertakings, such as railways, that produce immense beneficial results to the community at large, are frequently sources of loss and ruin to their proprietors as speculations. I therefore propose to show further on, that the establishment of motive power over the country will not only be the means of developing an unparalleled amount of prosperity, but that, viewed singly in the light of investment of capital, will be eminently reproductive.

In the selection of motive power for Victoria, the choice evidently lies between steam and water power. The difficulties and expense that attend the erection and maintenance of steam power up the country, present serious objections to its use; while the amount of capital consumed thereby being for perishable works, would be nearly two-thirds of that for water power, being for comparatively imperishable works; while the working expenses of steam would be, as I shall presently show, more than double that of water power. It is, however, quite unnecessary to educe any arguments in favour of the great superiority of water power over steam: such being only too apparent from experience.

The physical structure of Victoria is singularly favourable to the formation of water power by means of storage reservoirs, intersected, as it is, from east to west with the great Dividing Range: the lines of drainage flow therefrom with a rapid fall southward into the sea, and northward into the river Murray. In the vicinity of these ranges, along the water courses, many localities present themselves as suitable for the storage of water on a large scale; among which the Yan Yean Reservoir is a notable example. Throughout the country also the deep narrow valleys of the creeks, frequently one hundred and fifty feet deep, present favourable sites for making a succession of dams, by means of which large quantities of water can be stored and conveyed under pressure to lower levels: the water so collected in a deep narrow reservoir presents a small area to evaporation.

In the vicinity of the gold fields the elevations of the pri-

mitive formations, such as Mount Alexander, forming the sources of the creeks, present a height of fall above the country a few miles off, which can be usefully made available for conveying under pressure stored water from the sources to such distances as will give the desired fall and consequent power.

That water power may be obtained in almost every part of Victoria, does not admit of a doubt: the real question is, whether the establishment of water power throughout the country will be reproductive for the amount of capital sunk therein.

To investigate therefore the whole financial aspect of the question, and arrive at the probable cost and capabilities of storage reservoirs as prime movers in Victoria, I shall take the Yan Yean reservoir as being a great example, and estimate its reproductive capabilities, viewed as a motive power applied to various industrial purposes.

It may be remembered that the amount of water available from the Yan Yean reservoir for the supply of Melbourne, was estimated some time back by a committee of the late Philosophical Society at 22,000,000 cube yards per annum. The results since obtained in the reservoir appear to bear out this estimate. Mr. Hodgkinson's estimate of supply did not materially differ from the above, while he demonstrated the possibility of immensely increasing the supply by means of catchwater drains. I will, therefore, calculate the horse-power upon the committee's estimate of supply, although I believe it will be considerably exceeded by the result.

22,000,000 cube yards divided by 309, the number of working days in the year, gives 71,197 cube yards as the daily supply, weighing 56,636 tons. But 21,214 tons falling 1 foot in 24 hours, is 1-horse power: therefore the daily supply of 53,636 tons is $2\frac{1}{2}$-horse power per foot of fall. This multiplied by the head of 600 feet will give the total theoretical water power of the reservoir equal to 1500 horses.

Of this immense theoretical power, 80 per cent., or 1200 horses can be made available by means of the Turbine or horizontal water wheel, which from its simple and inexpensive construction is admirably adapted for attaining a rotatory motion from the pressure of water, and has been most successfully employed in giving motion to machinery in factories, while acting under different heads, up to 350 feet. By the intervention of this simple engine, the latent power of

the reservoir may be easily and economically brought to bear upon various industrial purposes.

The cost of steam power in Melbourne will form a correct basis for determining the commercial value of a horse power, which is based on the following figures, representing, for the most part, the actual cost at Mr. Fulton's establishment.

Expenses, including coals, attendance, wear and tear, tallow and oil—per horse power per hour	3.5d.
Then allowing interest at 5 per cent. on £300 per horse power, for erections, and machinery	.2d.
Management, and maintenance of buildings .	.1d.
Actual working expenses per horse power, per hour	3.8d.

This amounts to £139 per horse power per annum, being the actual working expenses of steam power. Now, if this power were leased out for manufacturing purposes, and a profit of 50 per cent. on the cost be assumed as legitimate, the whole commercial value of a horse power would be 5.7d. per hour.

Valued at this rate, the whole motive power of the Yan Yean reservoir of 1200 horses, would be worth £211,356 per annum.

I would estimate the working expenses of the Yan Yean motive power as follows:—

Interest on cost of works, embracing the reservoir and pipes to Melbourne, &c., &c., arranged for motive engines or turbines, buildings, &c. being 5 per cent. on 600,000*l.* for reservoir works, and 5 per cent. on 200,000*l.* for motive engines, buildings, &c. —per horse power per hour . .	1.0d.
Wear and tear of machinery, rated same as for steam engines—per horse power per hour .	.15d.
Management, wages, and maintenance of works, at 2½ per cent. on cost . . .	.5d.
Total actual cost per horse power per hour .	1.65d.

This estimate is equivalent to £51 per horse power per annum, or for the total power of 1200 horses, £61,182, being the whole working expenses per annum.

But as I have estimated above, the value of a horse power to be 5.7d. per hour, so 1200 horses power per annum is worth £211,356. If therefore from this amount the working expenses are, as calculated above for water power at £61,182 per annum, be deducted, there will be a clear profit left of £150,000 a year, obtainable by leasing out the Yan Yean water works as a prime mover.

With such a source of revenue, it becomes a matter for consideration with the public, whether they will pay as the cost of their water supply £60,000 a year for interest and current expenses, and by so doing refuse an income of £211,000 a year, of which £150,000 will be clear profit, and all for the enjoyment of the coveted waters of the Plenty.

It is, however, a redeeming feature in the Yan Yean reservoir, that from its capability of being easily converted into a motive agent, the great bulk of its power may be applied reproductively to industrial purposes as a prime mover, while a fractional part of the whole will be sufficient to raise from the river Yarra the ample supply of 50 gallons a head for 100,000 persons; and thus what is now an unproductive investment as a water scheme, may be converted at once into a reproductive prime mover, and an economical means of water supply. This I will attempt to demonstrate as follows:—

Fifty gallons a head per day for 100,000 persons equals 5,000,000 gallons, or 50,000,000 lbs., which, raised 130 feet high from the Yarra, constitute a resistance to be overcome requiring 138 constant horse power, working seven days in the week, or 160 horse power, working only six days in the week To attain this available power from the reservoir, a theoretical power of 200 horses must be expended, 80 per cent. of which being the useful effect, as before stated, is 160 horse power.

But as the whole power of the reservoir theoretically is 1500 horses, occupying 112 inches in depth, so 200 horses' power will occupy only 15 inches in depth, being nearly 3,000,000 cube yards of water falling 600 feet per annum, equivalent to an effective power of 160 horses.

It is thus apparent that 15 inches in depth abstracted from the reservoir, and used as a motive power in raising the Yarra water, is all that is required therefrom for the purposes of water supply of 50 gallons a head. The residue of the water in the reservoir, or 97 inches, equal to 1300 theoretical horse power, is therefore available as a prime mover for industrial purposes.

As the annual required supply of 50 gallons a head comes to 11,000,000 cube yards, and can be raised by 160 horse power, or 3,000,000 cubic yards in the reservoir, it is hence evident that every gallon of water in the reservoir is capable of raising more than 3½ gallons of Yarra water 130 feet high for Melbourne consumption.

The importance of this fact will be more apparent when the enormous saving effected thereby in the cost of water supply, as compared with the present gravitation scheme, is considered.

I have above estimated the cost of the Yan Yean motive power, including turbines or water-wheels at 1.65d. per horse power per hour. At this rate, 160 horse power, including interest, maintenance, and management, would cost £8,157 per annum: if to this amount be added £10,000, as the interest, at 5 per cent., on £200,000 for reticulation pipes, &c., and £2000 for wages of turncocks, &c., the whole cost of water supply will be in round numbers £20,000 a year, as obtained by using a fractional part of the Yan Yean Reservoir as a motive agent in raising the Yarra water up to the tank on Eastern Hill.

The estimates of cost of the two modes of water supply, as above detailed, will therefore stand thus:

Yan Yean Gravitation Supply, as being carried out, comprising interest at 5 per cent. on £800,000, and management, wages, and maintenance, at 2½ per cent. on cost	per ann. £60,000
Supply by Yan Yean motive power, 160 available horse power raising the Yarra water	£20,000

The ratio of cost is therefore as 1 to 3 in favour of the Yan Yean as a motive power.

If I have now satisfactorily demonstrated that an economical water supply may yet be obtained, and at only one-third of the cost of the present gravitation scheme; and this by the expenditure of only a fractional part of the resources of the reservoir; it hence becomes a question of deep import as to what reproductive purposes the motive power of the reservoir may be applied.

In every civilized country the possession of flour mills is indispensable, and hence motive power to work them. The increasing agriculture of this colony, not to speak of other interests, alone will demand the establishment of motive

power throughout the country, it will be hence interesting to investigate the reproductive results of such as applied to this branch of industry. I will therefore, taking the Yan Yean Reservoir as an example of water power generally, estimate its capabilities for the manufacture of flour.

The proportion of power to the quantity of wheat ground at Mr. Fulton's mill is 4-horse power to five bushels per hour. At this rate 1200-horse power would grind fifteen hundred bushels per hour.

The actual expenses at Fulton's for labour, superintendence, and everything but steam power, is found to be 8d. per bushel.

I will assume the cost of wear and tear of motive engines, oil, and tallow, &c., to be .15 of a penny per horse power per hour, which is the actual cost in some steam engines, and is equal to .2 of a penny per bushel of wheat.

The chief item of cost will be interest on expenditure, rated at £800,000 as the cost of the Yan Yean works, fitted with mill-machinery, buildings, &c., 5 per cent. on which will be per bushel ·86 of a penny.

The cost of the bushel of ground wheat will therefore stand thus:—

Labour and superintendence, etc., etc., per bushel	8.0d
Wear, tear, oil, and tallow - - do.	.2
Interest on expenditure for works - -	.86
And allowing for maintenance of works 1 per cent. on cost - - - -	.17
Cost, per bushel by water power	9.23d

The current price in Melbourne for grinding wheat is 2s. per bushel; hence there would be a clear profit of $14\frac{3}{4}$d. per bushel, which on 36,000 bushels, the amount that could be ground in twenty-four hours by the reservoir power, would amount to £2220 per day, or at the rate of nearly £700,000 per annum.

The above calculation shows not only to what profitable account the Yan Yean reservoir might be turned to hereafter, should agriculture become so developed as to lead to an export trade in flour from Melbourne, but also the reproductive results generally to be expected from the establishment of motive power throughout the colony as applied to agricultural requirements.

It could be easily shown that there are many other industrial pursuits to which the Yan Yean motive power might be

applied as a prime mover with profitable results, not to speak of the existence of such a power forming a great incentive to the establishment of manufactories of various kinds; indeed, with such splendid facilities, rendering Melbourne independent of coal, there is nothing to prevent its becoming a great manufacturing seat but the will of the capitalist.

There is, however, one source of Victorian wealth, which has of late assumed a vast importance, and although as yet in its very infancy, bids fair to attain a magnitude to which it is impossble to assign a limit.

In the quartz reefs of Victoria there is boundless undeveloped wealth, only requiring economical motive power applied judiciously, and on a vast scale, to eliminate it from its matrix.

Great as has been the success of quartz mining, it is undeniable that in its present state it is far from satisfactory. I believe if the subject be fully investigated, it will be found that the cause of non-productiveness lies in the isolated and unsystematic mode of operation pursued in the crushing and separating. The aggregate motive power on a gold-field is represented by a number of small steam engines scattered about, each requiring a separate staff of attendants, and thus is entailed a serious loss of labour. Besides the limited scale on which operations are carried on involve an undue proportion of working expenses generally. What different results might be expected if there existed in each auriferous district or gold-field, one large crushing establishment, managed by persons professionally competent, and who, having no quartz reefs or other occupation to divide their attention, would devote themselves wholly to the economical extraction of gold from quartz, and carefully adopt improvements according as they suggested themselves. I am firmly of opinion that the problem of the economical extraction of gold from quartz will be solved, not by this or that invention, but gradually, in precisely the same manner that the railway system has attained its present perfection—by self-development, the result of lengthened experience. To obtain this comparative perfection, however, it is necessary to carry on present operations on the right track, by concentration and magnitude of working, under the direction of persons specially competent.

In the absence of large crushing establishments on the gold-fields, as above recommended, we have in the Yan Yean Reservoir (aided as it will be by the projected railways from the gold fields) a vast prime mover available for the pulverisa-

tion of quartz, and therefore capable of testing on a magnificent scale, the applicability in an economical point of view, of storage reservoirs generally to the extraction of the mineral wealth of our quartz reefs.

It may, indeed be urged against such a proposition, that the cost of carrying by railway from the gold-fields to Melbourne of the ore would neutralise any advantage due to the economy of the reservoir power; but when the difference in cost, by working on a very large scale, as compared with a very small one, is considered, as also the very superior mode of working attainable thereby, the saving in supervision and wages, besides extracting from the matrix a larger per centage of gold, due to superior appliances and scientific management, unattainable on a limited scale, the extra cost of carriage will, I believe, form an inconsiderable item when set against the economy of working. Indeed so unsatisfactory is the system of working on the gold-fields, that large shipments of quartz have been made for England, and the consequent expense of transit incurred for the purpose of economically extracting the gold. At Anderson's Creek it has been found that quartz crushed on the spot yielded only 4 ozs. to the ton, while that from the same reef sent to Melbourne for crushing yielded 10 ozs. to the ton.

There are, however, other, and as potent reasons, in an economical point of view, for conveying quartz to Melbourne for crushing at a large establishment, in the absence of motive power up the country.

Railways are about to be launched upon the colony—primarily for the public advantage; and secondarily, for profit. It cannot be expected that when opened, the traffic of the colony will be sufficient to render them remunerative at the outset, although it may be anticipated that they will eventually create a paying traffic. During the early years of their existence, therefore, they will probably be working at a loss while accommodating the public.

Should however the completion of the main lines from Melbourne to the gold-fields be simultaneous with the sudden creation of a large traffic in quartz, involving also an accompanying passenger traffic, under how much more favourable auspices would such lines be started? I shall presently show that the water power of the Reservoir is sufficient to crush and separate 2,400 tons per day, which would therefore, represent the daily amount of traffic in quartz alone; I therefore conclude, that the establishment of quartz crushing

power in Melbourne is worthy of deep consideration, if only viewed in the light of its bearing upon railway interests.

I will particularise the more prominent advantages attainable by carrying on quartz crushing in large central establishments.

In the first place, on a large scale, such as proposed, the roasting of the ore, which so greatly facilitates its being crushed, could be effected economically by means of large ovens, scientifically constructed with a view to economy of fuel and the heating of large quantities at one operation, such being impossible on a limited scale.

Also, great economy in manual labour would ensue, as will be evident to all practical men, especially when it is considered that ten separate quartz mills, of ten horse-power each, will require six men each, or sixty altogether; while one quartz mill having the aggregate power of 100 horses would probably not require more than ten men.

The wear and tear of quartz mills, which forms a most serious item of working expenses would be considerably lessened under a systemised mode of working on a large scale, as, in connection with each establishment there would necessarily exist workshops for the timely repairs and maintenance of all the machinery, the want of which, under the present isolated mode of working, is the cause of the rapid deterioration of the machinery on the gold-fields.

In addition to these considerations, it should be borne in mind that in a large systematic establishment, with its tramways, self-feeding and delivering apparatus, &c., and all the appliances that science and capital can bring to bear—it is possible to perform by machinery many minor operations otherwise requiring manual labour, and that by magnitude and concentration of working generally, there is a special economy entailed, as is evident from experience.

But not the least important of the various advantages attainable by working on a vast scale will be the arrival at comparative perfection in the economical extraction of gold from its matrix. Under the eye of an experienced mechanician, the working will suggest by its very imperfection, from time to time, the obvious improvements. It is thus that railways and locomotives have attained to what they are, as the results of lengthened experience.

I will now submit an approximate estimate of what I conceive would be the cost of quartz crushing, &c., in Mel-

bourne, carried on under the circumstances as above detailed.

It has been found in practice that one horse power, working twelve hours, is sufficient to crush to a very fine powder one ton of quartz, and perform all labour required for separating the gold; this being also a low average, I will base my estimate thereon as follows:—

Cost of crushing power per ton being—	£	s.	d.
1 horse-power, working 12 hours, at 1·65d. per hour,	0	1	8
Roasting of ore, assuming that 1 ton of wood, at 10s., will roast 10 tons of quartz in properly constructed ovens,	0	1	0
Manual labour, allowing 1 man to every 10 tons, at 20s. for wages, as deduced from the opinions of practical men engaged in quartz mining,	0	2	0
Wear and tear of quartz mills, allowing half the existing amount under improved arrangements,	0	3	6
Carriage of quartz to Melbourne—average distance of 70 miles, at 3d. per ton per mile, coal being carried on the English lines as low ¾d. per ton per mile,	0	17	6
Then adding for superintendence and contingencies, 5 per cent. on the above,	0	1	3
Total estimate,	£1	6	11

To the above estimate of 27s. per ton I would invite the scrutiny of practical men, and, if found correct, will represent a considerable saving in quartz crushing, carried on as above proposed, as compared with the existing actual cost. The present charge for quartz crushing and amalgamating on the gold-fields is about 60s. per ton, of which the actual expense is about 40s. It is hence considered that ores containing less than an ounce to the ton will not pay, and are therefore worthless. It will, therefore, be apparent that, assuming the feasibility of my estimate of 27s. per ton, a much larger return can be obtained thereby from the present paying ores; and also those now considered valueless could be worked with profit, although only yielding half-an-ounce to the ton. That such results may be obtained, under the

conditions above set forth, appears probable from the fact of precisely similar results being obtained in the Mexican mines under inferior arrangements.

As in the above estimate of 27s. per ton, the principal item of 17s. is for carriage by railway from the interior, 70 miles, some deduction must be made therefrom in favourable cases, where the cost of transport will be materially less, owing to the nearness of the mines to the crushing power.

The Anderson's Creek gold-field, rendered interesting as the locality of the first discovery of gold in Victoria, is but 15 miles from Melbourne, and with the adjacent Caledonian gold-field, comprises an auriferous district of 75 square miles. The richness of the ores from this district is now an established fact; and the frequency and abundance of the quartz reefs give token of their inexhaustible character. Although this gold-field will probably not possess the advantage of railway communication with Melbourne, it is provided by nature and position with a much cheaper and more suitable means of transport to Melbourne: the river Yarra flowing through its centre can be rendered navigable for rafts drawing 4 inches of water by the expenditure of a few thousand pounds sterling, in partly removing the reefs and other obstructions that occasionally protrude above the summer level; and thus may the Anderson's Creek gold-field possess the cheapest of all kinds of transport for its ore to Melbourne, in the form of water carriage, enhanced as such will be with the current of the river in its favour.

As, therefore, the distance of this gold-field from Melbourne is only one-fourth of that of the other gold-fields, or under 20 miles, I will assume a proportionate rate of carriage, or 5s. per ton as the cost of transport of the ore to Melbourne: this item for carriage is 12s. 6d. under that of 17s. 6d. by railway from the other gold-fields, so that all other expenses being the same, the Anderson's Creek ores can be delivered, crushed and separated in Melbourne, 12s. 6d. cheaper than the other ores, or for 14s. 6d. per ton.

Assuming the soundness of the above calculations and views, the immense importance of working the quartz reefs at the very low cost of 27s. and 14s. 6d. per ton, and thereby opening up a far more extended field for enterprise in the poorer ores that are now unworkable, must be apparent.

As all the above calculations are based on the fact that one horse-power, working twelve hours, is sufficient to crush to a fine powder, and separate, one ton of quartz, and as the

estimated water power of the Yan Yean reservoir is 1200 effectual horses, it hence follows that it is capable of crushing and separating 2400 tons in 24 hours, or in a year of 309 working days 741,600 tons.

The annual yield of gold therefore, per ounce of richness would be 741,600 ounces, which valued at £3 17s., and lessened by the cost of crushing etc. 26s., would show a clear profit per ounce of richness, of £1,854,000 per annum.

If such a result is obtainable by means of the Yan Yean reservoir applied as a motive power, from the very poor ores of one ounce per ton, that are now considered almost valueless, may it not be reasonably expected that the most magnificent returns may be obtained from the ores of average richness—say, of only three ounces per ton.

I therefore submit, from the above calculations, that by judicious management in the selection and testing of the ores at the mines before being forwarded by railway, the Yan Yean reservoir notwithstanding its immense cost can be converted into a source of wealth as a motive power, and will produce thereby great collateral benefit to railway interests, inasmuch as the traffic accruing from the carriage of 2400 tons of ore (being the estimated amount the reservoir power can crush per day) to Melbourne, rated at only 3d. per ton per mile, would amount to £650,000 per annum, not to speak of the passenger traffic that must necessarily ensue therefrom.

However to fully appreciate the value of storage reservoirs as applied to the development of mineral wealth, they must be estimated as if on the gold-fields, and not necessarily involving cost for carriage by railway. If, therefore, the cost for carriage, or 17s. 6d., be deducted from the above estimate, there will remain 9s. 6d., or say 10s., as representing the cost of crushing, etc., per ton, on the gold-fields. As, however, there will always be some carriage from the different quartz reefs to the crushing power by means of tramways, I will allow 5s. additional for carriage for an average distance of five miles. My total estimate will therefore be 15s. per ton for the extraction of gold from quartz by means of the motive power derived from storage reservoirs on the gold-fields.

According to this estimate, the Yan Yean reservoir power, if situated at Bendigo, could produce, over and above all expenses, gold to the value of £7440 per day per ounce of richness, or nearly £2,300,000 per annum.

If such amazing results can be obtained from the motive power of storage reservoirs on the gold-fields, surely the cost of their construction, although large, need not form any impediment to their being established, especially when the capitals involved therein can be so speedily reimbursed.

The verification of the above estimate will be of the utmost importance to gold mining interests, as thereby will be demonstrated the possibility of working very poor ores, having only half an ounce to the ton, with the most profitable results; and thus would the auriferous fields of Victoria be practically enlarged and thrown open to industry.

It would not require much demonstration to show, also, that the washing of auriferous earths on a large scale could be effected in the most economical manner, as the same water that gave motion to the quartz crushing and puddling machinery could afterwards be used, when its power was spent, in the washing and cradling operations. The economical importance of thus reapplying the used water will be more evident when the vast amount of manual labour that is consumed on the gold-fields in puddling and cradling is taken into consideration, being probably one-fifth of the whole labour engaged in alluvial working.

I have now attempted to show what results may be expected from the application of water power on a grand scale to the development of the mineral wealth on the gold-fields, having based my estimates on the capabilities of the Yan Yean reservoir as a prime mover; my aim having been to demonstrate that water power is for many reasons the legitimate motive power for Victoria, and not steam; and further, that in order to economically apply that power to mining industrial purposes, concentration and magnitude of working must be adopted. It is needless to state, that if my estimates can be verified, the most astounding results as regards the production of wealth, can be obtained by the timely application of capital to the construction of storage reservoirs for water power throughout the auriferous districts. That such investment of capital would be largely reproductive, I have also attempted to prove, while the power so created would be always available for agricultural or other purposes.

There are, however, apart from the above considerations, the most urgent reasons for the establishment of storage reservoirs throughout the country, arising from the periodical droughts that occur in this colony. A repetition of the great drought that occurred some years back, and lasted through

several successive seasons, may not unreasonably be expected. If the results have been so calamitous when there was only a thin and scattered population, how much more intensely would such be felt now, when the population is increased fourfold, and concentrated in various districts! In a place like Bendigo, for instance, not only would the ordinary mining pursuits be suspended for want of water, but the inhabitants would be reduced to use impure stagnant water, should not even such fail, and then would sickness, disease, and death, be engendered. It is indeed impossible to predict what extreme consequences might result to dense populations such as on the gold-fields, from a recurrence of the great drought.

With the bare possibility of being revisited with such a calamity, not to speak of its probability, does not the very existence of the mining interests demand that precautionary measures be taken to avert the consequences? That the mining districts throughout the colony, containing each from ten to fifty thousand inhabitants, might possibly be suddenly deprived of one of the first necessaries of life, is surely sufficient to awake attention to the necessity of constructing storage reservoirs against the evil day.

Viewed, therefore, in the light of reproductive investments of capital, as prime movers for the development of mineral wealth, and also as a precautionary means to be adopted against the effects of periodical droughts, I submit that the establishment of storage reservoirs at the various gold-fields is not only advisable, but absolutely indispensable, to further industrial progress and security.

It will, however, appear a serious obstacle to the realisation of the above suggestion that the amount of capital required will be so large as to induce grave doubts as to the possibility of obtaining it, notwithstanding that its investment in the manner proposed will be highly reproductive. In carrying out all great public works, however, it must be borne in mind that posterity reap the chief advantage; while the promoters, having undertaken all the expense and risk in their execution, are frequently unrewarded by immediate reproductive results. If, therefore, motive power be established in Victoria at an immense outlay, and if the nature of the works involved thereby, being of a permanent and lasting character, are serviceable for succeeding centuries, as railways are, it hence appears simply just that the cost of such works should be borne by posterity, while the present gene-

ration will have accorded all their due in originating and carrying out such, and paying the interest on their cost of construction.

If such reasoning is admittedly applicable to railway formation, I maintain it is infinitely more so to the establishment of motive power in Victoria. Railways, at best, are only auxiliaries to industrial development, while motive power is the very essence thereof. The former may be dispensed with, and have been hitherto; but motive power must be had in some form or shape. Hence it is that a large amount of capital has been expended in steam power on the gold-fields, in order to carry out the most limited operations. Experience has shown that steam power is not very well suited for the interior of this country, owing principally to the absence of the means of maintenance, and the expense of working on a limited scale. Besides, the capital expended in steam power will be for perishable works, lasting little more than one generation, and hence in that time becomes exhausted, while that expended in water power will be for an unlimited period, like railways.

Viewing the permanence and superior importance to the colony of water power over railways, the expense of its establishment presents no reasonable objection thereto, inasmuch as railways have been pronounced necessary, and their expenditure warrantable. If ten millions are about to be sunk in railways as only a means to an end, such an investment can be more judiciously made in directly promoting that end, being industrial progress, and thereby collaterally creating occupation for railways. Besides, investment in motive power will be highly reproductive, as has been shown in the preceding calculations; while it cannot be expected that railways will pay even working expenses for some years after their construction, owing to the present smallness of the population. Were ten millions invested in water power, it may be true that it would be considerably more than present requirements would demand, and might consequently for the present be unproductive; but the fact of the existence of such an industrial agent being dispersed throughout the auriferous districts, would present such an inducement to non-capitalists to follow mining pursuits, that crowds of immigrants would flock to these shores, and thus would the present wants of the colony be supplied by an increasing population.

In dealing with this important subject, I have been influ-

enced by the necessity of drawing attention to the simple fact that the absence of motive power in this colony is the great drawback to its industrial advancement. That in a place like Victoria, so incomparably rich by nature, and where manual labour is necessarily so dear, such an anomalous state of things should exist as that a large proportion of that manual labour should be absorbed in operations that are only suitably performed by machinery, appears strange indeed with the example of England for a guide. I maintain that every man engaged in work such as can be effected by machinery, as puddling or washing auriferous earth, is lost to the colony, because such a man might otherwise be most profitably engaged in skilled labour; but this state of things must unfortunately exist until motive power and machinery be brought to bear upon colonial industry. Blest as this country is by Providence with such vast natural wealth, and having also the means for obtaining loans for public works, to continue the present miserable system of developing that wealth, and to leave to the unassisted efforts of private individuals what requires a concentration of effort and capital, is but trifling with a great subject, and is a reproach to the enterprising spirit of the colonists.

In conclusion, I beg to submit the following points in my paper for your consideration.

That it is indispensably necessary to the adequate development of the mineral wealth of Victoria, that motive power, on a large scale, should be established at the various centres of industry.

That the most legitimate mode of effecting that end is by means of water power obtained from storage reservoirs, for which the physical features of the gold-fields are peculiarly favourable.

That such reservoirs as prime movers will be highly remunerative for the capital invested in their construction, and will be of incalculable benefit in time of great drought.

That with a view to render the Yan Yean Reservoir highly reproductive, it is expedient to convert it into a motive power for the crushing of auriferous quartz carried by railway from the gold fields, and for other manufacturing purposes. That Water Supply for Melbourne may be economically obtained by employing a small portion of such power in raising from the river Yarra fifty gallons a head up to the tank on Eastern Hill.

I have the honor, Mr. President and Gentlemen, to submit

the calculations and views in this paper for your consideration with the utmost diffidence, and with the humble hope that whether borne out, or otherwise, they will draw such attention to the real requirements of industrial progress as is demanded by, and only consistent with, the prospective interests of Victoria.

ART. XII.—*Museums in Victoria.*—By FREDERICK MCCOY, Esq., Fellow of the Geological Society of London, Honorary Fellow of the Cambridge Philosophical Society, and Professor of the Natural Sciences in the University of Melbourne.

THE use of museums, as a means of conveying valuable practical information to the masses of the public, has only of late years been perceived by the British people. It is only recently that the British Government has imitated the course pursued by the rulers of all the civilized states of Europe and America, and established practical Government Museums in the three kingdoms, under the titles of Museum of Practical Geology, Government School of Mines and of Science applied to the Arts, Museum of Economic Geology, Museum of Irish Industrial Resources, Museum of the School of Fine Arts, &c., and very many of even the better informed classes of the public cling to the old notion of a museum being at best a place merely for innocent amusement of schoolboys and idlers; a place, like Shakspeare's Apothecary's shop, where

> ——————" a tortoise hung,
> An alligator stuff'd, and other skins
> Of ill-shaped fishes"

might be gaped at, and where such other dusty odds and ends as stray contributors might give, should be locked in cases, without labels or classification, or other essentials, to make them useful—in fact, the more incomprehensible the objects, the better is the estimation of the lovers of these old fashioned " raree-shows "—and it is only within the last few years that our countrymen are beginning to find out that, under proper direction, and as managed in modern times, museums become the most ready and effectual means of communicating the knowledge and practical experience of the experienced few, to the many who, under less favourable circumstances, are

engaged in, or mean to enter upon, those useful pursuits of life which depend more or less directly upon a knowledge of the peculiarities of the raw materials which Nature furnishes to us.

It has been suggested to me that as some even of our scientific fellow colonists held these old notions, a few observations on modern museums in general, and suggestions for the formation of such as would be useful to the people of this colony, might prove acceptable; and I have accordingly put the few following notes together to offer you this evening, placing them under separate heads, for convenience of reference.

GENERAL OBSERVATIONS.

All the more enlightened nations of Europe have long found it profitable to vote annually considerable sums for the prosecution of scientific researches, and the maintenance of museums in all the principal towns in which the eye of the unlearned could be familiarised with natural objects, with the principles of classification applied to them by scientific men to place their peculiar characters and mutual relations in a striking light; and with specimens and models of machinery illustrative of the arts and manufactures. Such museums, more or less good, exist, endowed from the public purse, in nearly all the large University Towns of the Continent of Europe; such the United States have been organising at great expense, in connection with the Government Natural History and Geological Surveys during the last twelve or fourteen years; and such the Board of Trade have more tardily established at home with the most gratifying success. For Victoria, I have no doubt that, with slight modifications, the series of museums established by the British Board of Trade would form the best precedents. They may be divided into Museums of Natural Science and its applications, and Museums of Art. Although these are partially combined in all cases, yet the division is useful, and I shall treat the two kinds separately.

MUSEUMS OF NATURAL AND APPLIED SCIENCES.

These have for their object the exhibition to the public of examples of all the natural products of the earth, or particular parts of it, carefully labelled with the name, the locality whence obtained, and such other information as would indicate the nature or uses of the particular object. And as every country possesses natural resources with which it is the in-

terest of the community to be acquainted, it has been recognised as an imperative duty by all intelligent governments, to have surveys and collections made by competent persons of all such things, and to have the results of such investigations, whether specimens of the animal, vegetable, or mineral kingdoms, deposited in some scientific establishment, where they could be carefully preserved for public instruction, and be freely open to public inspection, and where they should remain for verification, in after times, of the data on which the various Government Reports, &c., were founded.

The Victorian Government initiated measures of this kind long ago, and by His Excellency, Mr. Latrobe, a Government Botanist (Dr. Müller) was appointed to collect all the plants of the district, and report on those furnishing timber fit for various purposes, and those affording the various valuable gums, dyes, medicines, tannin, &c., which it might be expected the plants of the country would yield to the manufacturer acquainted with their appearance and properties. A Government Zoologist (Mr. Blandowski) was also appointed, who has made a highly attractive collection of most of the indigenous birds and mammals, as well as of a considerable number of the shells, sponges, &c., and a few of the fishes of the neighbouring sea. A Government Geologist (Mr. Selwyn) was also appointed, and brought out from England, to examine and report upon the rocks of the country, and to combine his observations into a geological map, to be published by the survey department; to make such a geological survey as the Board of Trade is having made for the United Kingdom, in connection with the School of Mines and Museum of Economic Geology in London; or such as Professors Hall, Rodgers, Emmons, &c., are doing for the United States, or such as Haidinger is superintending at Vienna for the Austrian Government.

Having been myself, many years ago, a member of the Geological Survey of Great Britain, which is the finest in the world, I am in a position to speak of the first-class excellence of the work already performed by our Government Geologist, and to say, that the map and sections now preparing for publication, are such as any country might be proud of: they are on the same plan as those of the British Survey, and are quite worthy of being placed beside them. The extent of country surveyed by him is also remarkable, when the difficulties under which he laboured, from having so small a staff, and insufficient topographical maps, are considered.

The Surveyor-General, too, with that zealous love of applied science, and skill in command, by which work of extraordi-

nary goodness is got out of ordinary workmen, for which his corps has become so famous at home and abroad, has made great and useful collections for the public, of the rocks, building stones, ores, soils, &c. of this country; which collections he could (if there was a place to hold them) increase to any extent without appreciable cost to the Government, by directing the attention of his surveyors to those matters which necessarily come under their notice in the daily discharge of their field duty.

All these works, accumulating the materials for a National Museum, were commenced long ago by the Victorian Government, and are continued to the present day. I am also informed that, two or three years ago, the Government had determined to appoint a Director of the Museum, in accordance with the system pursued at home in the great national museums to which I have alluded. This officer has been found by experience to be absolutely necessary for the satisfactory carrying out the objects of such institutions. At home the office is always filled by some man of established reputation and varied scientific knowledge—Haidinger, the great mineralogist, for instance, has been appointed by the Emperor, Director of the Vienna Museum; Prince Charles Lucien Buonaparte, one of the most accomplished of living naturalists, has been appointed Director of the Paris Museum; Sir Henry De la Beche, and, at his death, Sir Roderick Murchison, received the appointment of Director of the London Museum of Practical Geology, with its branches of Natural History and School of Mines. Sir Robert Kane is Director of the Government Museum of Irish Industrial Resources, including the Survey Natural History Collections, and it was understood that the corresponding office in Scotland was to have been filled by the late Professor E. Forbes, in connection with his Professorship of Natural Sciences in the Edinburgh University. It is to be regretted that this office was not filled up at the time, as from the known zeal of the gentleman indicated to me as at that time willing to undertake the duties, we might now have had the advantages of a harmonious action between all branches of the public service, able to advance the end in view; and by a judicious direction of each into the proper channels of inquiry, and impartiality and skill in dealing with the results of the various labours for the public benefit, the various materials really obtained might be combined into a valuable public collection.

Another obstacle to the formation hitherto in Victoria of a great National Museum, was the want of a suitable

building to hold the specimens. The town having now the large Museum built expressly for the purpose by the University, and part of the ground floor of the Public Library, removes this obstacle to the bringing the scattered fragments of collections together; and although we have as yet no complete Museum, it will be seen that we have the materials for a very great and good one, and unusually favourable opportunities for completing it on the most approved plans.

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§ *a.* Botanical Museum.

Collections for the exhibition of classically arranged plants are of two sorts: 1st, Botanic Gardens for living specimens; 2nd, Herbaria for dried plants. Both kinds should be fostered; and accordingly both kinds have already made considerable progress in Victoria.

The public Botanic Gardens, under the able superintendence of Mr. Dalachy, afford the citizens the most delightful promenades, amongst well kept flower borders, trim walks, a rich collection of flowering shrubs and herbaceous plants, and the most beautifully situated piece of landscape gardening that can be conceived in this country. But as here (very properly I think) beauty of arrangement has been permitted to dominate over the grim precision and gridiron-like order of a strictly scientific Botanic Gardens for class purposes, I have been furnished by the Council of the University with means for the formation of a Botanic Garden of this latter kind, which is now being laid out, and with the help of Mr. Dalachy, and many other public and private rearers of plants, who have promised their aid, we expect to have within the year a good collection, illustrative of all the natural *Classes*, *Orders*, and most of the *Families*, and many of the *Genera* of plants, arranged with the systematic precision of the leaves of a book, and fully labelled in the way adopted by my friends Professor Henslow and Mr. Babington in the new University Botanic Garden at Cambridge. Each *Class* having a large bed to itself, with a label bearing its name in the centre, of such a size, that it can be read from any part of the margin: this bed is divided by small fences into smaller divisions, containing each one of the subordinate *Orders* of the *Class*, these again being subdivided into *Families;* and these into compartments for the *Genera;* each subordinate division in the classification being marked by a conspicuous, but progressively smaller, label, until finally the *Species* placed in each generic compartment have ordinary

sized labels, setting forth the *Genus*, *Species*, *Locality*, and common name of each. A garden well labelled in this manner will teach the principles of botanical classification, even if but poorly furnished with plants, and the eye of the visitor will familiarise him insensibly with the natural alliances and affinities of the various groups of plants, and suggest the relations which the scientific botanists have detected and used for their classification, even when as yet we may be deficient in many of the typical specimens. These, I have every hope, however, will not long be wanting.

The Government Herbarium, collected by Dr. Müller, contains a collection of dried specimens of great value, of most of the native plants of Victoria. This hitherto has been tied up in bundles, and kept in the little cottage in the Botanic Garden, where the workmen took their meals and slept, and where, consequently, visitors would scarcely like to intrude. It has now been transferred by the Commissioner of Public Works to the University, where it will be most carefully preserved, as the original specimens on which the printed reports of Dr. Müller were founded. It is at present undergoing a thorough repair, I having found living larvæ half an inch long, and numerous destructive *Termes*, *Psaci*, and the like, ruinously at work in the first parcel which came under my care. We are having a suitable case made for its reception in the new University Museum, where, in a month or two, it will be ready for reference. The very intelligent University gardener, W. Hyndman, is forming a supplementary Herbarium of the introduced plants, including those coming into flower in the Botanic and other gardens. Mr. Wilhelmi, the assistant Government botanist, will furnish us with a suite of his South Australian plants; and I have written home for an extensive Herbarium of the plants of other countries for comparison.

A museum of this sort should have, however, in addition to the above, a well-prepared suite of preparations and dissections, illustrating all the parts of plants, examples of all the tissues, the organs, with their more striking modifications of development in flower and fruit. All the structural peculiarities which have received particular names in the writings of botanists, should be illustrated by typical prepared examples, to which full descriptive labels should be attached, so as to clear, as much as possible, difficulties from the way of persons entering upon the study. A still more serious defect in the present public botanic collection, in the mind of one who likes to see science applied to the useful purposes of life, is the absence of speci-

mens of the useful vegetable products of the colony. It is of importance to the community to have publicly exhibited examples of all our native woods, from the timber excellent for shipbuilding, and those good for house carpentry, and of special utility for certain parts of machines, to our most beautiful black-wood, and other rich sorts, for fine cabinet-makers' work; the latter in manufactured and polished pieces. We should also have well-prepared specimens of the tannin from our bark; our indigo and other dyestuffs, our gums and other medicinal products, should appear as they might be prepared for the market. Sir W. Denison's experience of the facility with which potash can be manufactured from the ashes of our forest trees, should be illustrated by samples of the prepared alkali of the ash, and of the timber it was from, with descriptive labels. It would be the duty of a "Director of the Museum" to see that such specimens as these were procured and exhibited, for though of the highest interest to the public, they are almost sure to be neglected by the enthusiastic scientific collector, because no *scientific* interest attaches to them, and such observers, led away by the desire for novelty and many distinct species, are apt to forget that these are but the means to an end, and that those "merely useful" matters, instead of being neglected, should be brought prominently forward.

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§ *b.* Zoological Museum.

Zoological Museums are either local or general: the first being as complete a series of species as possible of some particular locality; the latter being principally generic types from all parts of the world.

It unfortunately happens in this, as in other departments of science, that the showy and useless has received more attention than the apparently insignificant creatures that for good or for evil most concern mankind. Thus the natural history of Birds has usurped a most undue share of attention: Quadrupeds have been less studied or collected; and some of the more economically important lower groups are almost unknown. Thus there is scarcely a moderately perfect collection of Fishes in existence, although the fisheries of various countries are of such high importance to man. Thus scarce a year passes but some of the German princes expend a large part of their income to fee scientific commissioners to examine and report upon some of the minute beetles, or other insect destroyers of their pine forests,

although if the museums were supplied with the small and ugly creatures as abundantly as with the showy ones, the insects would long ago have been perfectly well known to every entomologist of Europe. Sir Wm. Denison figures and describes the *Lymnoria terebrans*, a little crustaccan no bigger than a pin's head, which he convicted of the destruction of the sub-marine piles in Tasmania while he was Governor there, which a less acute observer might have supposed to have simply rotted; yet, so inveterate is the habits of collecting only pretty things for museums, that this creature is almost unknown in Europe, where it has been described by three different observers, under three different names; and when I was last in the company of a great English authority on entomology and minute crustacea, I surprised him by the assertion that the *Mylostoma* of Allman, which destroys the wooden piers on the Irish coast, was this same little creature, which Della Chiagi had long before described at similar mischief on the piers of the Two Sicilies. Then, again, when the Hessian fly appeared first in numbers in Europe, and a famine was dreaded from the destruction it occasioned to the wheat crops, there was scarcely a museum in Europe contained a specimen, and the creature was supposed to be unknown, simply because then, as now, it was not the fashion to collect the smaller *Diptera*. The fly which kills the vine—the fly which destroys the turnip crops by eating the two first young leaves—and, in fact, the great majority of the insect annual destroyers of millions worth of property, are rarely to be met with in museums. Here, again, is another instance of the necessity of having always a Director at the head of any publicly endowed Museum, independent of the collectors; for they say, with some reason, that they must make some show, or the οἱ πολλοὶ will think them idle; and if they looked after these matters, a year's collecting might fit in a hat, and they might lose their situation. A superior officer, to come between them and judgment, is, therefore, necessary. The known Mollusca (*Teredo*), Crustacea (*Lymnoria*), and insects most destructive to property, whether growing crops or manufactured timber, one of each, put together, would fit in a wine glass; yet, for the public service, it is far more necessary that they should be collected and investigated than all the most brilliant birds and butterflies the world ever saw.

(Continued at page 159.)

ART. XIII.—*Phenomena of Hailstorms in Victoria.* By R. BROUGH SMYTH, C.E., F.G.S., Hon. Sec. Phil. Inst. of Victoria, &c., &c.

HAILSTORMS are not uncommon in this country during the months of June and July. They also occur during the warmer months, and at periods when it is extremely difficult for the meteorologist to account for the congelation of waters at the altitude of the storm-clouds. The formation of hailstones, during the winter season, may be accounted for in part by the extremely low temperature of the air, as ascertained at the surface of the earth; yet the circumstances under which they congeal are unknown to us. It is frequently observed, for instance, that snow is falling on the ranges at the sources of the Dandenong, within thirty miles of the City, at an elevation of 1,500 feet, while showers of hail and rain are descending on the Plains, near the level of the sea.

The hail storms, during the winter season, appear to be quite distinct from those which occur during the summer, and properly may be considered separately. I shall place before you, very briefly, some of the phenomena of these meteors:—

On the 11th June, 1855, rain commenced to fall smartly at 6½ a.m., the barometer falling very slowly, the reading at 9½ a.m. being 29·945 in., and the thermometer indicating a temperature of 44° Fah., the air being completely saturated. The sky cleared a little at noon, the breeze having freshened from the south, and large dark grey cumuli were moving slowly northward—the barometer remaining steady. At 2 p.m. the temperature had risen to 47°, the dew point being 40°, when a smart shower of hail and rain fell. In this instance the barometer was remarkably steady, rising only 0·10 in. in six hours when corrected for diurnal range; and no sudden changes of wind occurred.

On the morning of the 12th, the lowest temperature recorded was 35°, and at 5½ a.m. heavy showers of hail and rain fell, continuing, at intervals, until 9½ a.m. A very faint breeze blew from the west, and the barometer, at 9½ a.m., had risen to 30.112 inches. In this instance, as in the former, no sudden changes of wind occurred. The clouds were dense and of a cold grey colour, alternately of the cumulus and nimbus form, the edges being of a silvery whiteness. They appeared to be of little elevation.

On the 17th June, 1856, showers of hail and rain fell at 1.30 p.m. The highest temperature recorded that day was 51.1°. It blew a brisk breeze from the west, and the barometer was moderately high and very steady. Dense nimbi formed in the S.W., and hail fell as the heavy clouds were borne overhead. The dew point during the day remained steadily at 41.8°.

On the 11th June, 1856, heavy showers of hail and rain fell at 9.30 a.m. The barometer had been as low as 29.659 inches the previous night, and had risen to 26.788 inches when the showers fell. The temperature of the dry bulb was 41.0°, and the dew at 37.6°. The highest temperature recorded during the day was 48.2°, and the temperature of the dew point altered very slightly. A brisk wind blew from the south, and no sudden change had occurred. Heavy showers of hail and rain again fell at 9.30 p.m., the clouds being of a dense grey colour.

The great similarity of the circumstance attending the hailstorms above described is somewhat remarkable, occurring as they do at similar seasons notwithstanding, for we might have expected them to have been connected with and modified by electricity; but in no instance was thunder heard or lightning seen. Electricity may, however, have been one of the causes of the decrement of caloric, and most probably on the 11th of July, when the atmospheric pressure was only equal to 29.659 inches mercury, considerable electrical disturbances did take place, though unobservable;* yet I am inclined to favour the opinion of Mons. Gay Lussac, who snpposes that the sudden cold is most often caused by radiation from the upper surfaces of the clouds.

Again, when we consider the indications of the barometer, we may suppose that the refrigeration is caused by the descent of cold currents of air; and during the winter season, with the thermometer at 54°, this is not very improbable. This theory is favoured by the circumstances, also, that these hailstorms are partial, generally very narrow in the track, and almost invariably accompanied by a squall of wind. Olmsted adopted this view, and subsequently abandoned it when he found it insufficient to account for hailstorms in India. This theory, and that of Gay Lussac, may serve to explain these meteors during our winter season, and to disconnect them altogether with the hail observed during the heat of summer.

It has been observed that hailstorms most often, but not

* See Views entertained by Humboldt. Cosmos—Vol. I., p. 189.

always, occur at the periods of the greatest heat of the day, and my observations during the past eighteen months confirm the general truth. Aware of this, Humboldt suggests that the dilation of the ascending current of air may account for the intense cold. This, again, would explain many of the winter storms, but could not apply to those of summer. Hailstorms during warm weather are, I believe, due to the meeting of opposing currents of air. This theory was originally proposed by Kamtz, and it has been corroborated by the observations of other meteorologists. In this country double currents of air are very often observed. Sometimes cirri may be seen at a great height moving slowly from the N.E., while scud and cold grey clouds are passing rapidly from the S.W., at an inconsiderable elevation. Now, we can easily comprehend how, under such circumstances, very considerable changes of temperature would take place, if by a decrease of atmospheric pressure, the north-east wind were to descend and mix with that from the south-west. Similarly, the converse of this would produce great changes, and as an illustration, I will describe the storm of the 23rd September, 1856. On the morning of the 23rd, the barometer had fallen to 29.793 inches, and dull grey clouds covered nearly the whole sky, the wind blowing briskly from the north. The temperature rose rapidly during the morning, and the sky cleared before noon. The thermometer continued to rise until about 2 p.m., the highest reading being 72 deg.; at half-past 3 p.m., it had fallen to 70.0 deg., the dew point being 56.5 deg., and the barometer had fallen to 29.682 deg. in. The wind, still from the north, was light. At this period of the day evidences of the coming change were observable in the sky. In the southern and western quarters dark cumuli were seen, which, at 4 o'clock, took the form of the cumulostratus clouds. They were large, and of a dark cold grey colour. At half-past four the wind suddenly changed to S.W.; small detached patches of dark scud of a remarkable appearance moved irregularly northward, joining the larger clouds at the base, and the barometer was observed to rise very slightly. Peals of thunder were heard as soon as the gust of wind came from the S.W., and violet-coloured forked lightning was seen three or four times. Rain and hail immediately followed the electric discharges, and the storm was of such violence, that cattle trembled and fled for shelter to the streets, exhibiting every sign of terror. Where the rain and hail fell most heavily, it was scarcely possible to see fifty yards

in advance. In about twenty minutes ·920 in. of rain was collected in the rain gauges. The path of this storm, from all accounts I can collect, appears to have been very narrow, and most violent in the northern parts of the city. The hail-stones were not large. On the following day the barometer rose rapidly, the weather was cold but fine during the morning, and after mid-day large *cumuli* and *nimbi* formed, and showers of hail and rain fell. At Geelong the storm was not felt.

It is not my intention to enter into any discussion of the many probable causes of the decrement of caloric suggested by such details as above described. Atmospheric electricity is not yet sufficiently understood to enable us to explain its influence satisfactorily in connection with the great and sudden changes of temperature which so often occur during thunder storms. It is evident, however, that the old theory of a cold current of air blowing against a rain cloud will not explain such phenomena. From whence could such a cold current come? And under what peculiar circumstances could it preserve its temperature? The collision of two currents of air of different electrical states, whatever the previous temperature of those strata may have been, is immediately followed by violent changes both of humidity and temperature; before the equilibrium is restored, successive flashes of lightning are seen, and during the period of the storm the thermometer by its indications shows the extreme rapidity of the changes; and that the thermometer, at the surface of the earth, only very faintly expresses the alternations of heat and cold in the higher regions where the storm clouds are, is proved by the state of the wet bulb, which not unfrequently is altogether irreconcilable with rain, when rain is actually falling.

I have hastily compiled these notes; but they will not be useless if they direct attention to the most remarkable phenomena of our climate.

ART. XV.—*Report on the Steps taken in England to provide a Telescope for observing the Nebulæ of the Southern Hemisphere.* By PROFESSOR WILSON, M. A., Melbourne University.

THE Report which I have now the honour to lay before the Institute is little more than a narrative of the steps taken by the British Association for the Advancement of Science, in

conjunction with the Royal Society of London, in order to procure the erection of a telescope of great optical power, at some suitable station in the Southern Hemisphere. It has been drawn up in consequence of a wish to that effect expressed at a meeting of the Council of the Institute. I trust, however, that it will not be considered altogether out of place if I prefix a brief notice of some of the principal steps in the history of what has been called "Stellar Astronomy."

Before the invention of the telescope the total number of stars visible in the whole heavens might be differently estimated at from 4000 to 6000, according as the eye of the observer was more or less piercing, so that the whole number visible at any one time above the horizon would not exceed from 2000 to 3000. The first great step was made in 1610, when Galileo directed his telescope to the heavens, and announced that the luminous belt, called the milky way, was but a vast aggregation of stars.

Passing over the speculations of Keppler, we next find it stated by Huyghens, in a work published in 1698, three years after his death, that the stars are suns like our own; and the immensity of their distance was inferred by him from the absence of any discoverable parallax. For nearly sixty years this branch of astronomy was stationary, till Kant, in 1755, published his work on the theory of the Heavens, containing a series of speculations, many of which, viewed by the light of modern science, appear almost prophetic.

Lambert, about the same time, was carrying on a series of observations for determining the distance of the fixed stars, and their distribution in space, by comparing the light proceeding from them with that of the planets. He classified the stars in groups of various orders. Thus he considered the sun and planets as a group of the first order. Our sun and the fixed stars as a group of the second order. The milky way he pronounced to be a cluster of such groups of the second order, forming itself a group of the third order. And he propounded the hypothesis that the nebula of Orion was also a group of the third order; another milky way adjoining our own. He also assigns universal gravitation as the common bond of all these systems.

A few years later, in 1767, the Rev. John Michell also published a Memoir on the determination of the distance of the stars by photometric observations.

For the next half century the history of Stellar Astronomy is the history of the labours of Sir William Herschel, con-

tained in seventy-three memoirs, scattered over the thirty-nine volumes of the Transactions of the Royal Society from 1780 to 1818. The six principal points to which he directed his attention have since formed the six branches into which the study of the Fixed Stars has been divided.

1. On their Nature and Brightness.
2. On their Parallan.
3. On their proper motion in space.
4. On Double and Multiple Stars.
5. On Clusters and Nebulæ.
6. On the Construction of the Heavens and the Milky Way.

The labours of this great man, as a mechanician in forming his telescopes, as an astronomer in using them, and as a philosopher in reading the tale which they unfolded, are too numerous to admit even of an enumeration here. I cannot, however, refrain from making an extract from his Memoir of 1818.

" In the depths of the celestial regions we have recognised " up to the present time two different principles—the nebular " principle and the sidereal principle. The light of the nebu- " lous matter is comparatively very feeble, and, except in some " cases, invisible to the naked eye. It is in general widely " spread over a great extent of space, thus being concealed " from the view by its extreme feebleness. The light of the " stars, on the contrary, is comparatively very brilliant, and " concentrated in a point." Further on he states, that " It " is extremely probable that some of the cometic nebulæ, " many among the planetary nebulæ, and a considerable num- " ber of the stellar nebulæ, are disguised clusters of stars, " being plunged so far in the depths of space, that the guag- " ing power of the telescope has not yet reached them."

Though multitudes of these nebulæ have since yielded to the superior telescopic power that has been brought to bear on them, and shewn themselves as clusters of stars, yet the question of the existence of a nebulous matter distinct from the stars, and irresolvable by any telescopic power, is still far from settled. Dr. Whewell, the present Master of Trinity College, Cambridge, in an Essay recently published, speaking of the Magellanic Clouds, says, " In those regions of space " there co-exist, in a limited compass, and in indiscriminate " position, stars, clusters of stars, nebulæ regular and irre- " gular, and nebulous streaks and patches. These, then, are

" different kinds of things in themselves, not merely different " to us. There are such things as nebulæ side by side with " stars and clusters of stars. Nebulous matter resolvable " occurs close to nebulous matter irresolvable."

The consideration of the Magellanic Clouds at once brings us to the labours of Sir John Herschel at the Cape of Good Hope, where he spent the four years, from 1834 to 1838, in completing the survey of the heavens, commenced by his father, by adding to his catalogue the double and multiple stars and nebulæ of the Southern Hemisphere.

At the time when Sir John Herschel was thus working at the Cape, and when the best telescopes of the public and private Observatories of Europe and America, if not adding much to our knowledge of the nebulæ, were showing that the law of gravitation extended to those regions of space, by proving that many of the double stars described ellipses round each other under their mutual attractions, Lord Rosse was working in Ireland with untiring perseverance at the production of a telescope of vastly greater power than any yet attempted; and this, the six feet reflector, was so far finished as to be available in February 1845. Lord Rosse himself thus states the result in a report laid before the British Association at Birmingham in 1849. " In the first instance it was directed to " some of the brighter nebulæ in Herschel's catalogue. Many " of them were immediately resolved, and very frequently " the aspect and form of well-known nebulæ were completely " changed, fainter details not previously seen being brought " out by the great light and magnifying power of the te- " lescope."

Amongst the various results described by Lord Rosse in this report, the most remarkable is the discovery of the spiral arrangement, till then unknown, and undistinguishable with the inferior telescopes which had been previously used, but which has since been observed in many nebulæ. This and other new and symmetrical arrangements thus brought to knowledge, open up vast fields of inquiry as to the mechanical conditions under which they exist, and render it highly desirable that every possible step should be taken to increase our knowledge of those inexplicable objects. Impressed with the importance of the object, the Association resolved on applying to Her Majesty's Government " to establish a reflector " not less than three feet in diameter, at the Observatory at " the Cape of Good Hope, and to make such additions to the " staff of the Observatory as may be necessary for its effec-

"tual working;" and accordingly the following Memorial, drawn up by Dr. Robinson, the eminent Astronomer of Armagh, at that time President of the Association, was presented to Lord John Russell:—

"My Lord,—At the last Meeting of the British Associ-
"ation for the Advancement of Science, that Assembly came
"to a resolution which has been adopted by the Royal
"Society, and which therefore I am directed, conjointly with
"the President of that illustrious body, to lay before your
"Lordship.

"The purpose is, that the Government be requested to
"establish, in some fitting part of Her Majesty's dominions,
"a powerful reflecting telescope (not less than three feet
"aperture), and to appoint an Observer charged with the
"duty of employing it in a review of the Nebulæ of the
"Southern Hemisphere."

"In evidence of the high importance of such an investiga-
"tion, it is sufficient to refer to the way in which its proposal
"was welcomed by the British Association. That assembly,
"comprising upwards of 1500 persons, among whom were
"found almost every British name of scientific renown, and
"of whom all are more or less devoted to the pursuit of
"physical knowledge, may not unfairly be considered an ex-
"ponent of the national mind on such an occasion; and I
"have never seen it admit any similar resolution with a more
"enthusiastic approval.

"For the department of Nebular Astronomy is that which
"at present has the most powerful hold on public attention,
"and stands most in need of public assistance. Others are
"worked out by the pen and in the closet, or by instruments
"of easy attainment, and in establishments already fully
"organised: the only results which they can now yield are
"uninteresting except to a few, and are valued by the mass
"only from an instinctive perception of the glory which they
"confer on human intellect. But it is far otherwise with
"this; the mysterious forms on which it is employed are at
"present objects of universal curiosity, from their position,
"(outworks as it were of the universe), their evident analogy
"to the system of which we are a part, and which we may
"hope to study in them, and the Dynamic questions which
"the marvellous arrangements of many of them suggest. I
"may add, that in its origin it is almost exclusively ours;
"the fame which will reward its completion should be ours
"also. The history may be very briefly given. About

" sixty-eight Nebulæ had been ill seen and worse described, " when the elder Herschel was led to explore them by the " encouragement and aid of his sovereign George III. To " those previously known, he not only added 2500 more, but " by classing them, by clear and methodical description, and " directing attention to the relations which connect them with " other portions of the universe, he gave this branch of " astronomy its powerful vitality. His no less distinguished " son, following his example with even greater success, has " not merely extended the list of northern nebulæ to an " amount which would have ennobled any other name, but has " given the whole work complete precision by an accurate " determination of the position of all contained in his own " and his father's lists, thus placing them fully within the " reach of subsequent observers. Not content with this, he " transported to the other hemisphere those instruments which " had rendered such good service in our own, and has thus " enriched astronomy with 1600 more, equally well observed, " but beyond the reach of European astronomers.

" Yet powerful as those instruments were, a much nearer " approach to the extreme limit of *useful* optical power has " been made by Lord Rosse: it was therefore to be expected " that his telescope would add considerably to our knowledge " of the Nebulæ, and this has been fully realised. It was in " fact a communication of some results obtained by him which " directed the attention of the British Association to this sub- " ject, and excited a desire of having the same work performed " for the southern sky which he is accomplishing in our own. " That work implies a minute re-examination of at least all " the brighter Nebulæ of Sir John Herschel's catalogues; " embodied in drawings, based on micrometer measures, and " so correct that each of them may be referred to without " doubt by future astronomers as an *authentic record* " of the original's appearance at a given epoch. Of such " drawings we at present possess very few: most of the " sketches given by the Herschels are stated by them to be " made merely by eye; and even those that were more " accurately taken by them are found to require amendment " when compared with the appearances in more powerful " telescopes.

" A task of this kind can only be wrought out by severe " and long continued labour; and the instrumental means " required are such as very few individuals can obtain by " their private resources. Even in Europe there are but

"three telescopes known to exist which are capable of making any great additions to the discoveries of the Herschels; "and those three are in the British Islands. This field of "research is therefore still exclusively our own; and I trust "your Lordship will share my feeling, that the nation's "honor will be sullied if we let it be preoccupied in its most "interesting portion by the energy and liberality of any other "people.

"In submitting to your Lordship this request of the "British Association, I feel it my duty to give with it some "approximate estimate of the sum which might be required "for its accomplishment.

"First, as to the instrument; it has been proved by the "experience of Lord Rosse, Mr. Lassels, and others, that "one of sufficient power can be constructed with certainty "and at no overwhelming cost. I have made inquiries of an "artist (with whose abilities in this line I am practically "acquainted), and have come to the conclusion that a telescope similar to the smaller of Lord Rosse's, 3 feet aperture "and 27 feet focal length, might be constructed for £2,000. "This would include an equatorial mounting; clock-work, "to make the telescope travel with a star; apparatus for "supporting the observer; and a machine for polishing the "speculum, when that operation may be required. If a second "speculum were supplied (which seems almost essential in "case of accident), it would add about £500 more. Of "course, some latitude must be allowed in this, but it need "not be wide; the work could not be completed in less than "a year, possibly would employ two. As telescopes so "gigantic are erected in the open air, no outlay would be "necessary for any building except the Observer's dwelling.

"Secondly, the Observer need not possess very high "mathematical attainments; acute sight, and skill as a "draughtsman, being his most important requisites; and his "staff need not consist of more than two or three labourers, "one of whom should be a practical mechanic.

"I am quite aware that there are some persons who will "consider the sum that I have named above, and the moderate annual expenditure which would be required for a few "years, a very unprofitable waste of public money. I feel "also assured that your Lordship is not of their number; no "man can be who has ever drunk of the fountain of knowledge, or added to the domain of intellect. I feel confident "that the public itself is not with them, and that it would

"resent as an insult the imputation of valuing at a mere "market price the only true elements of personal dignity or "national glory. If the spirit of the age be such that "the most despotic sovereigns of Europe feel that they "cannot avoid the necessity of encouraging physical science, "much more does it belong to the rulers of the freest and "most enlightened nation of the world; and it is due to your "Lordship and your colleagues to say, that we have always "found you to carry out in the fullest extent the requirements "of science.

"In hopes that in this instance, also, our appeal may not "be in vain,

"I have the honour to be,

"Your Lordship's obedient servant,

"T. R. Robinson,

"President of the British Association for the Advancement of Science."

"The Right Hon. the Lord John Russell."

On the 14th August, 1850, a reply to the Memorial was sent by the Lords of the Treasury, to whom it had been referred by Lord John Russell, in which the writer, stating this, says, "I am directed to inform you, with reference "thereto, that while my Lords entertain the same views as "those expressed by you, as to the interest attaching to such "observations, yet it appears to their Lordships that there is "so much difficulty attending on the arrangements, which "alone could render any scheme of this kind really beneficial "to the purposes of science, that they are not prepared to "take any steps without much further consideration.

"I am, &c.

"G. C. Lewis."

The Council reported to the meeting in 1851, at Ipswich, that they had communicated this reply to the Council of the Royal Society, who had concurred in the recommendation; accompanying the communication with an assurance that the British Association will not lose sight of this important object, and requesting the continued co-operation of the Royal Society. That the specific difficulties alluded to in this letter

had not been communicated by the Government; but that they entertained the hope that they were not of such a nature that time and further consideration would not remove them, and concluded by expressing their belief that the time was not far distant when the subject might be again and successfully brought under the consideration of her Majesty's ministers.

The Astronomer Royal, in his address at the same meeting, stated his opinion that when a more explicit plan had been formed, another representation would be accompanied with success.

At the meeting which was held at Belfast in the following year, 1852, the President, Colonel Sabine, thus referred to it in his address:—

"Among the subjects which are likely to come before the "Mathematical and Physical Section, there is none perhaps "of greater importance, or requiring more careful considera- "tion, than the question, whether the time is arrived when "the establishment of an Observatory in the Southern He- "misphere, furnished with instruments of suitable optical "power for the examination of the Nebulæ of the Southern "Heavens, and devoted exclusively to that branch of Sidereal "Astronomy, should be again brought under the considera- "tion of Her Majesty's Ministers. . . . . .

"In the discussions which took place at a former period, "the only difficulty which appeared to be apprehended in "reference to the successful working of such an establish- "ment, arose from a doubt whether mirrors of the required "magnitude could be repolished, as they would frequently "need to be, on the spot. This difficulty has now, it is un- "derstood, been entirely removed by the improvements which "the Noble Earl, the President of the Royal Society, to "whom science is so deeply indebted for the instrumental "means of prosecuting these researches, has made in the appa- "ratus for repolishing the mirrors, and in the instructions for "the guidance of those who may have occasion to employ it, "which his own great personal experience has enabled him to "prepare. In this happy country, in which men are free to "consider and to discuss the propriety of public support being "given to undertakings conducive to national honour, and are "encouraged to do so by the experience that public men of "all parties who succeed each other in administration, seek "to be guided by enlightened public opinion, we may justly "entertain the full conviction that measures which, from their

" intrinsic importance, deserve to be adopted, will, sooner or " later, obtain the consideration they merit. When such pro- " positions are brought in the first instance—as in the class " of subjects with which we are here concerned it is desirable " they should be—before those public bodies, which are justly " regarded as possessing the highest scientific authority in this " country, and as most competent to judge of them, they " cannot be too carefully considered and discussed, before, by " their adoption, they become invested with the authority and " weight which those bodies have it in their power to im- " part. But when after due deliberation they have been so " adopted, it is equally fitting that these public bodies should " be true to their own convictions, and should steadily per- " severe in urging, on all proper occasions, both publicly " and privately, the measures which they believe will add to " their country's honor. . . . . That an observatory " for the purpose specified, in a part of the globe where it can " render peculiar service, and where we possess facilities " which other nations do not possess, will ere long be estab- " lished, no one I believe entertains a doubt. The importance " was admitted by the Ministry to whom the recommendation " was made. The only question with them appearing to be " one of time."

A little further on he observes:—

" Hitherto the researches of sidereal astronomy, even in " their widest extension, had manifested the existence of " those forces only with which we are familiar in our own " solar system. The refinements of modern observation and " the perfection of theoretical representation, had assured us " that the orbits in which the double stars, immeasurably dis- " tant from us, revolve around each other, are governed by " the same laws of molecular attraction which determine the " orbits of the planetary bodies of our own solar system. " But the Nebulæ have revealed to us the probable existence " in the yet more distant universe, of forces with which we " were formerly wholly unacquainted. The highest autho- " rities in this most advanced of all the sciences, acknowledge " themselves unable even to conjecture the nature of the " forces which have produced and maintain the diverse yet " obviously systematic arrangement of the hosts of stars which " constitute those few of the spiral Nebulæ which have been " hitherto examined. Hence the importance of increasing

" our knowledge of the variety of forms in which the " phenomena present themselves, by a similar examination " of the Southern Heavens to that which Lord Rosse is " accomplishing in the Northern Heavens."

The following resolution was accordingly passed:—" That " it is expedient to proceed without delay with the estab- " lishment in the Southern Hemisphere of a telescope not " inferior in power to a three feet reflector; and that the " President, with the assistance of the following gentlemen, " viz., Lord Rosse, Dr. Robinson, Lord Wrottesly, J. C. " Adams, Esq., the Astronomer Royal, J. Nasmyth, Esq., " W. Lassell, Esq., Sir David Brewster, and E. J. Cooper, " Esq., be appointed to take such steps as they shall deem " most desirable to carry out the above resolution."

At the next meeting, held at Hull in 1853, the Council reported that the committee above named, having added to their number Sir John Lubbock, Sir John Herschel, John Phillips, Esq., and the officers and council of the Royal Society, had decided on the nature and size of the telescope, and the mode of mounting which they deemed most advisable, and had appointed a deputation to communicate with the Earl of Aberdeen, with the view of obtaining the sanction of her Majesty's Government, and the requisite funds for the construction of the telescope.

The Council added that the deputation was favourably received by Lord Aberdeen, and that they had reason to entertain the hope that the necessary funds for the construction of the telescope would be included in the estimates presented to Parliament in the next session.

Mr. Hopkins, the President, in his address, gives the following account of the proposal:—

" You are aware with what a noble devotion to science " Sir John Herschel spent several years at the Cape of Good " Hope in the examination of the Southern Heavens; but " his telescopic power was limited to that of a reflector of " $18\frac{1}{2}$ inches aperture. It is now proposed to send out to " some convenient station in the southern hemisphere a re- " flecting telescope with a mirror of 4 feet aperture. Mr. " Grubb, of Dublin, has undertaken to construct such an " instrument (should the plan proposed be adopted) under " the general superintendence of Lord Rosse, Dr. Robinson, " Mr. Lassell, and one or two other gentlemen. The " general construction of the instrument, and the best mode " of mounting it, have been decided on with careful

" deliberation, after consulting all the best authorities on the " subject.

" These important preliminaries being agreed upon, and " an estimate of the whole expense of the instrument having " been made by Mr. Grubb, the deputation appointed for the " purpose proceeded to wait on Lord Aberdeen, to ascer- " tain whether the Government were willing to bear the " expense which the plan proposed would involve. His " Lordship expressed himself without hesitation as favorable " to the undertaking; but said that since it involved a " grant of money it would be necessary to consult the " Chancellor of the Exchequer, who, supposing him to take " a favourable view of the subject, would probably bring " it before the House of Commons among the estimates of " the ensuing year. With this answer the deputation could " not be otherwise than perfectly satisfied. . . . Judg- " ing from all we know of Mr. Gladstone's enlightened " views on subjects of this nature, and the favorable manner " in which the House of Commons has always received pro- " positions for the advancement of science, we have, I think, " every reason to hope that my successor in this chair may " have the satisfaction of announcing to you another instance " of the liberality of the Government in their acceptance of " the plan proposed to them."

His successor, the Earl of Harrowby, in his address at Liverpool in 1854, stated, in reference to this subject—" You will regret to hear that, although the estimate was not objected to by the Government, it has not yet been submitted to Parliament. We must make some allowance for the pre- occupations of war."

In answer to some inquiries which I sent home last year, after my arrival in this Colony, I received the following answers from Dr. Robinson, one of the Committee :—" 1. " There was no formal engagement. Lord Aberdeen told us " that he approved; that he could give no definite promise " till he communicated with the Chancellor of the Exchequer, " but that he was confident no objection would be made. " Lord Rosse, who was spokesman, considered the matter " settled. But the war prevented any further proceedings. " 2. The telescope was recommended by the Committee to be, " on a proposal made by Grubb, 4 feet aperture, not ex- " ceeding 36 feet focus—probably 30—to be Cassegrainian. " It was to be equatorially mounted on a new plan proposed " by him, with clockwork. The estimate was £4,500, but

"the Committee asked Lord Aberdeen for £5,000. How-
"ever, the war prices of everything would require the esti-
"mate of everything to be raised now. 3. We prefer a re-
"flector, because to equal a 4-feet reflector in illuminating
"power would require a 3-feet achromatic, of which there is
"no chance in our time. Mertz, when questioned for a
"30-inch one, said, *if it were possible to make it*, the object
"glass alone would cost £9,000. As to tarnish, we contem-
"plate repolishing, which, on Lord Rosse's plan, presents no
"serious difficulty; and the estimate included a polishing
"machine and steam-engine to work it. 4. We contemplate
"mere nebulæ work, and perhaps satellites of Uranus and
"Neptune. The telescope was to be *sub dio*. The staff
"was to be—one observer, two labourers, and a mechanician,
"to be paid by the Admiralty."

As to the facility of re-polishing, I may quote a statement of Lord Rosse's, in answer to a question of Dr. Robinson on the possibility of its being practised with success by persons who had not had the long experience and mechanical knowledge of his Lordship? He (Lord Rosse) said that he had recently made many experiments with 3-feet specula in reference to the object of Dr. Robinson's question; and, in particular, had found that, by increasing the speed of the second eccentric in his machine, the process was rendered so much more certain, that desiring one of his workmen (a smith) to perform the whole process *without any superintendence* on his part, he produced a speculum, not perhaps absolutely perfect, but capable of doing excellent work. He had no doubt that any person of ordinary mechanical capacity would be able to do as much with a little instruction; and he would be most willing to give that instruction to any observer who might be placed in charge of a large reflector.

Though, in the later recommendations to the Government, no particular place was pointed out as the site for the erection of the telescope, it cannot be disputed that, even when not expressly mentioned, the Cape of Good Hope was the locality indicated by the Committee of the British Association, selected, probably, for the double reason of possessing already a working observatory, and as having been the scene of Sir John Herschel's labours in the same field; and should the expense of carrying out this proposal be defrayed by a vote of the English Parliament, there can be little doubt that that would be the spot selected.

But the latitude of Melbourne is nearly the same as that

of Cape Town. In transparency of atmosphere it can vie with any country in the world; as the metropolis of the great nation of the south, it possesses means and appliances, wealth and energy, with which no place on this side of the equator can enter into competition. But with these should come, also, the feeling that it is a duty to make use of them. It may be said that the English Government, now that the war is over, will resume their intention and carry out the views of the Committee. It may be so. All the louder, then, in my opinion, is the call on us to lose no time in seizing an opportunity, which seems specially offered to us, of proving to our friends at home, what they are but slow to believe, that we appreciate higher things than the gold we produce so abundantly, and that we value that gold chiefly as placing at our disposal the means of aiding every truly great and noble work. Our stepping forward now to carry out an object which has so long occupied the attention of the scientific world in England will at once place this Colony in the foremost rank of nations, patrons of science.

In the representations made to Her Majesty's Government, a re-survey of the southern nebulæ only was contemplated; and to the carrying out of this, some advantage would undoubtedly arise from the juxtaposition of the Cape observatory. But though this object only was aimed at, it must not be inferred, therefore, that there is no other astronomical work of importance which can only be done in a southern latitude. Upwards of seventy observatories, public or private, are constantly at work in the northern hemisphere, determining and catalogueing the places of the stars; and yet their work has not been exhausted. Stars may still be numbered by tens of thousands, of which either the positions have not been recorded, or the records depend on unsatisfactory observations. How much more, then, is there work to be done in the southern hemisphere, where two or three observatories only are engaged in the task. And yet it is on this steady work—little as may be the popular interest it possesses while in progress—as much as on the more brilliant observations which have been the subject of my communication this evening, that the determination of the laws which govern the motions of the vast cluster of suns, of which our sun is but an equal amongst equals, must ultimately depend. The accurate determinations which we now possess of some of the most important astronomical elements depend on the rough observations of the ancients. And who can say what revelations

regarding our system would not have been made now, if we possessed a map of the stars made a thousand years since which could boast a hundredth part of the accuracy of that which all the astronomers of the world are now engaged in producing. The effect of an error in depreciating an observation diminishes with the lapse of time; and, conversely, increased accuracy will enable the same riddle to be read in a shorter period.

This work, though at first sight it appears different, is really, in its ultimate object, identical with that done in careful observations of the nebulæ. In the one case, we are placed at a vast distance from the cluster we are observing, and can examine and record its appearances at different epochs, and from these can draw conclusions as to the arrangement and motions of the several bodies of which it is composed. In the other case, we are in the midst of such a cluster; and our mode of proceeding is to observe and record with the greatest accuracy to which our instrumental means will enable us to attain, the positions of the individual bodies of which our cluster is composed, that by comparing these positions at different epochs, we may deduce their motions, and analyse them into such as are actual motions of the stars, and such as are mere parallactic effects depending on the motion of our system, and from which the motion of our system may be determined. Such a series of observations, and the comparison based on it, will be incomplete, if one portion only of the heavens is taken into account.

To do this work efficiently, an Observatory, furnished with fixed meridian and prime-vertical instruments of the first class, is requisite; and the establishment of such an Observatory, in conjunction with the erection of the four-feet reflector, is a noble object, to which some portion of the apparently inexhaustible wealth of our gold-fields may be worthily devoted. It remains for the Philosophical Institute to say whether they will take any steps to draw the attention of the Legislature to the subject.

Art. XV.—*The Nest, Egg, and Young of the Lyrebird—(Menura Superba).* By Ludwig Becker.

Until lately, the egg of the Lyrebird was unknown in Europe. During the Melbourne-Paris Exhibition in 1854, Messrs. Williams and Leadbeater exhibited a case containing stuffed Lyrebirds and an egg of the same. By permission of the owners of the egg, I made a drawing of it, and sent the sketch to the Professor of natural history, Dr. Kaup, in Germany, who presented it for publication to Dr. Cabanis, in Berlin. From this time the egg of the Menura Superba has, in some measure, become known at home. The fact of the well known French naturalist, Jules Verreaux, requesting that my original drawing of the egg might be forwarded to him, proved that the subject was not wholly devoid of interest. The aborigines who brought the egg to Melbourne, belong to the Yarra tribe; and one of them possessing a higher degree of civilization and intelligence than the rest, and who is looked upon by his tribe as a sort of leader, is the son of the Yarra tribe chieftain, who, with other chiefs of the country (which forms now part of the county of Bourke), brought the curious land sale with Batman to conclusion. The son's name is Simon, and I put myself in direct communication with him, in order to obtain as much information as he, from his own experience, could give concerning the native animals, etc. By presenting him and one of his relations with their respective photographic portraits, I succeeded at last in making them fulfil a long-given promise, and accordingly they brought a nest and egg of the Menura Superba to Melbourne. To-day I have the honor of laying before you all the new details gathered from the aborigines and other acute observers, as also my own remarks, together with the original nest and its contents.

Bullan-Bullan is the name which the aborigines of the Yarra tribe give the Menura Superba. The word has some similarity to the gurgling tone which the bird at times is heard to emit. The favourite place chosen by the Bullan-Bullan for building its nest, is the dense scrub on the slopes of deep gullies, or in thickly grown small plains, lying between the bends of rivers, but still in the vicinity of mountains. Here the bird selects young trees, standing close together, and whose stems form something like a funnel. Between the saplings, one or two feet from the ground, it makes fast its nest; sometimes it may be found also upon

the trunk of a tree, hollowed out by some bush fire; or it selects a fern-tree, of not too great a height, for the same purpose. The nest proper is ten inches in diameter, and is five inches high. It is closely woven together from fine but strong roots, and the inside is lined with the softer feathers of the bird. Round this nest the bird builds a rough covering, composed of sticks and pieces of wood, grass, moss, and leaves, in such a manner that it projects over the genuine nest, affording the sitting bird a shelter from above. An opening in the side of the nest serves as an entrance, through which the female enters backwards, with her tail laid over her back, and, with watchful eye and ear, keeps her head in the direction of the opening. The female lays only one egg a year, of the size of a duck egg. Its colour is of a light ash gray, with darker spots slightly tinted with brown. The colour resembles in fact so closely the colour of the feathers with which the nest is lined, that it is not easy to detect the egg; it would seem, indeed, as if nature wished to protect this species of the feathered tribe "*ab ovo.*"

It is generally believed that the Menura Superba make use of the same nest for several years. The nest and egg before you were found on the 31st of August inst., and arrived in Melbourne on the 4th of September, in a good state of preservation. This is somewhat astonishing, considering that the "black fellow" carried them on his back by day, wrapped up in his Oppossum-skin, while by night he had to protect them from the wild cats and other animals. In Melbourne, unfortunately, or rather fortunately, the egg was broken, and an almost fully developed young one dropped out, which would, in the course of two or three days, have broken through the shell itself.

The young one is almost unfledged, having only here and there feathers, resembling black horse-hair, of an inch in length. The middle of the head and spine are the parts most thickly covered, while the forearm and the legs are less so. A tuft is visible on its throat, as also two rows of small and light coloured feathers on its belly. The skin is of a yellowish grey colour, darker at the feet; the claws are grey, and the beak is black. The eyelids are closed, but not grown together.

I believe that the period of incubation of the Lyrebird begins in the first week of August, and that the young one breaks through the shell in the beginning of September.

Art. XVI.—*Tenacity of Life in the Platypus, (Ornithorhynchus paradoxus.)* By Ludwig Becker.

In the middle of the month of September a living male Platypus was brought to Melbourne, when I had a good opportunity of making the following observations. When I saw the animal for the first time, it was lying rolled up and seemingly asleep in a large wooden box. I removed it from there and placed it in a bucket full of water, in which the animal swam about for a few seconds, and placing the tip of its bill upon the edge of the bucket, it blew the water, which had accumulated in the mouth, through the nostrils. The animal then moved the hairs, which covered the cavities of the ears, up and down at pleasure (as if they were the ears themselves), showing here two dry spots, which contrasted greatly with the surrounding wet and darker coloured hairs of the head. The Platypus remained but a few minutes in the water, after which it crawled over the edge of the vessel on dry ground, and searched for some comfortable nook, wherein to repose after its involuntary bath. If by chance it happened to meet with moist ground, it dabbled about in it with its bill, after the manner of a duck. Upon my endeavouring to lift it up by the head, it made so desperate a defence, striking and scratching my hand so effectually, that I was obliged to leave the animal alone. On one of the hind feet was fastened a piece of string, intended as a safeguard against escape; seeing, however, that the foot was much swollen from the pressure, I cut the bonds, thereby allowing the Platypus to wander free, so far as the extent of the box would permit, having provided a supply of water and food, of which, however, the captive did not seem to partake. On the following day it had lost much of its vivacity and strength, which I attributed to its obstinately refusing all nourishment; it became daily weaker, and I saw there was no hope to keep it alive. A short time before its death I heard the poor animal moaning and groaning like a child whose end is fast approaching; its sides panted very much by each respiration; the inhaled air was emitted through the nostrils with a sigh; and the poor creature was soon freed, without convulsions, from bondage and all its pains.

A post mortem examination showed the following remarkable facts. The Platypus had been fired at, while swimming in the river Ex, and the shot had taken the following effect: The whole of the back was covered with blue spots, without

the shots, however, having penetrated the skin, which fact can be accounted for by the Platypus swimming in such a manner as to leave only a part of the head visible. One shot went through the jaws, another in the left eye, destroying it totally, and the skull was fractured to such a degree that several particles of the cranium penetrated the brain, and were found there together with masses of coagulated blood. The wound in the head was nearly an inch long and half an inch broad. Besides this, one of the hind feet was so much swollen and inflamed that its colour was blood red, and the skin had been cut here in order to form an issue, which, however, had not taken place.

Taking all these circumstances into consideration, it appears that the Platypus possesses a tenacity of life not very likely to be found in animals of the higher order. The Ornithorhynchus, indeed, deserves also, in this respect, to be called "paradoxus."

Art. XVII.—*Native Zinc embedded in Basalt.* By Ludwig Becker.

On the 26th of October, 1855, a piece of metal was shown me here in Melbourne, by Mr. W. Clarke, the well-known gold broker, who also mentioned that it had been found in a block of basalt, not far from Melbourne. I immediately hastened to the spot in order to learn something more particular about the interesting find. The locality is a basalt quarry near Brunswick, at the back of the Collingwood Stockade. The finder of the metal gave me the following particulars, which were corroborated by a dozen workmen, who were present at the find. The man spoke as follows: "Look here, Sir, the 'Bluestone' begins about four "feet below the surface, and I bored a hole in a solid piece, "5 feet by 4, in order to blast it. As soon as this was done, "I commenced breaking the large pieces of stone with a "heavy hammer, and out of one of the pieces, a white mass "fell on the ground, which I, out of curiosity, picked up. I "found it rather heavy, and wishing to know what it was, I "broke the mass, which presented then a blueish white and "brilliant shining metallic surface. Thinking it to be silver, "I requested one of my neighbours to show it to Mr. "Clarke, and the piece you hold in your hands is the identi-

" cal piece I sent him. It splintered into several pieces " upon my breaking it, some of which are on my mantel- " piece, some in the hands of neighbours. The piece, when " unbroken, was flat, and about the size of a child's hand. " It lay in a cavity of the bluestone block, and the sides of " the cavity were covered with a similar substance, and of " the same dirty white colour, as the coating or covering of " the metal. I can swear to what I have here stated." The man here finished his relation. It was impossible for me to find the identical fragment of the bluestone block containing the cavity, still the specimen of rock before you is a piece of the same block in which the metal was found. I visited the quarry often during the space of fourteen months, and made strict search and enquiry in order to ascertain whether deceit or imposition had any hand in the matter; I returned home each time in the belief that the workman's depositions were true. Besides, I offered the quarrymen a sum of money should they procure me a further supply of specimens, which however, I have not yet been so fortunate as to obtain; if the metal before you were an artificial fabricate, surely the men, should they be deceivers, would have produced more specimens in the hope of obtaining the promised reward.

I have to thank Mr. George Ulrich (a gentleman employed by the Mining Commission, and whose ability, as also care and exactness in analysing inorganic bodies is well known) for the following results of experiments with a blowpipe on the metal.

" The metal, when heated in the oxydising flame, colours the flame whitish green. It phosphoresces very brilliantly, while being transmuted into a white not fusible oxide. When heated on charcoal in both flames, it gives the coal a coating of a yellow colour, which, when cooled, appears white. When moistened with cobalt solution and then heated, the coating of the coal assumed a beautiful green colour, and phosphoresces strongly during the operation. The metal imparts no colour to the borax pearl or the phosphoric salt pearl, they became however milky on a larger supply, especially when moved in and out of the flame. In the reducing flame they became milky white of themselves. The following results appeared from experiments made on the whitish-yellow crust or coating, which was formed on the metal. The crust, when heated in the flame, phosphoresced strongly without melting; when heated on coal it shows the same reaction as the metal itself; the coating and the green

colour produced by the cobalt solution are especially manifest. The borax pearl takes a yellow colour in both fires (oxide of iron) accompanied by an effervescence (carbonic acid); after this, it takes a greenish, and, upon cooling, a light blue colour of such a tint as clearly to indicate the presence of cobalt. The same appearance is visible in the phosphoric salt pearl; in the reducing flame it was a mere greenish blue. When I examined the crust closely with a magnifying glass, I discovered in the cavities and fissures of the coating, small hair-like films or tufts of a peach-blossom colour, and when brought into contact with the borax-pearl, this pearl was coloured with a deeper blue. This pink coloured matter was not found in sufficient quantity to allow further experiments. To judge from appearance it is Cobalt-Bloom. When the crust is brought into contact with acids, it dissolves easily with effervescence, and, with caustic alkali, it precipitates in a white downy substance, and dissolves again when the caustic alkali is used in excess. According to these reactions in the wet as well as in the dry manner, it allows us to come to the conclusion that the coating is Zincspar (Calamine); although it is possible that this crust be oxide of zinc with carbonate of lime; for the white sugar-like substance, which is found so often in the cavities of the so-called bluestone, is also carbonate of lime (Arragonit). As a proof of the purity of the metal itself, this circumstance is in its favour, viz.: That it shows no precipitate when dissolved in nitric acid and brought into contact with sulphohydric acid; and, on the contrary, that it shows a pure white precipitate when brought into contact with hydrosulphuret of ammonia. Those metals which render zinc impure, such as cobalt, cadmium, lead, &c., are not found in this piece, or, when present, in only extremely small quantities."

The specimens before you were in one piece, which, when complete, weighed circa four ounces and a half. The specific gravity is about 7.*

I believe this to be the first time that zinc was found in a native state, and the circumstance of its being found here, in Victoria, will be a sufficient excuse for my having so long tried your patience.

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* Fracture: in one direction laminated, in the other partly perpendicularly striped, partly, like the Turmalin, of a prismatic construction.—L.B.

PROCEEDINGS.

PROCEEDINGS, &c.

REPORTS OF THE MUSEUM COMMITTEE OF THE PHILOSOPHICAL INSTITUTE OF VICTORIA.

REPORT *of the* COMMITTEE *of the Philosophical Institute of Victoria, appointed at a General Meeting, held 20th May, 1856, for the purpose of memorialising his Excellency the Acting-Governor on the subject of the Removal of the National Museum, and also on the expediency of allotting some room for the use of the Philosophical Institute.*

MR. PRESIDENT AND GENTLEMEN,

Your Committee, in order fully to carry out their object, proceeded in the first instance to enquire into all the particulars of the case, and held several meetings, to give the matter due consideration. On the 11th inst., they definitely agreed upon the tenor of their Memorial, and his Excellency having been pleased to appoint the 17th inst. for the purpose of receiving the deputation, your Committee waited on his Excellency that day, Captain Clarke being present at the interview, when the Chairman presented the following Memorial. (A.)

His Excellency, who was pleased to receive the deputation throughout with marked courtesy, expressed his gratification to see such a matter so warmly taken up, and seemed very desirous of ascertaining all the particulars of the subject.

The Deputation, after presenting their Memorial, explained more fully to his Excellency their views on the different bearings of the subject, urging, that on public grounds their prayer recommended itself to the favourable consideration of his Excellency,—that the study of natural sciences, although highly desirable, had hitherto been too much neglected, and that a really National Museum was one of the means of remedying this,—that whereas

the removal to the University buildings would virtually render the National Museum unavailable to the great majority of the public, the location in the Library building would, on the contrary, bring a large number in daily contact with it, the day visitors to the Library having already amounted to 80, and a considerable increase being anticipated; that the National Museum had already acquired considerable importance, owing to the exertions of those connected with it, the number of specimens amounting to upwards of 6,000; that the lower hall of the Library building, although not combining all the advantages that might be desired, was yet very suitable for the temporary reception of the Museum; and, that when the proposed enlargement of the Library building took place, adequate provision might be made for the proper reception of the National Museum, in which case the removal would be attended with trifling cost or risk to the specimens.

His Excellency acknowledged the desirability of rendering the National Museum as accessible as possible to the public; at the same time, he believed that during the administration of the late Governor, some arrangement had been made about the temporary location of the Museum at the University buildings, but that this was by no means intended to be a permanent transfer of the National Museum to the University, as it was proposed ultimately to erect a suitable building where the Museum would be located. His Excellency was also of opinion that the concurrence of the Trustees of the Library would be necessary to the proposed arrangement.

Your Committee suggested to his Excellency that, in October last year, the Philosophical Institute had already represented to the late Governor the impolicy of removing the Museum to the University, and that, should any arrangement have been entered into with the University, they believed that the Corporation of that Institution, when the matter was laid before them, would not desire to offer any impediment to so publicly useful a measure as that proposed by the Philosophical Institute, more particularly as the removal to the University buildings was of so entirely a temporary nature, calculated to afford no ultimate advantages to that institution; they also stated that they anticipated no insurmountable objections in such a cause from the Trustees of the Public Library.

His Excellency, in conclusion, assured the deputation that it would afford him much pleasure to be able to effect such an arrangement as would be satisfactory to all parties, and requested Captain Clarke to communicate with the respective institutions, to ascertain what could be effected in the matter.

On the subject of the room for the use of the Philosophical Institute, his Excellency was also pleased to desire Captain Clarke

to communicate with the Trustees of the Library, with a view to meet, if possible, the prayer of the deputation.

In concluding their report, your Committee would recommend the appointment of a standing Committee for the purpose of watching over the progress of the case as regards the National Museum, and taking any further steps that might be required, such Committee also to endeavor to obtain the desired accommodation for the Philosophical Institute.

ARTHUR DOBREE, Chairman.
S. IFFLA.
THOMAS E. RAWLINSON.
DAVID E. WILKIE, M.D.
FREDK. ACHESON.

Melbourne, 19th June, 1856.

(A)

(COPY.)

To his Excellency Major-General Edward Macarthur, Commander of the Forces in the Australian Colonies, and the Officer Administering the Government of Victoria.

The Memorial of the Committee of the Philosophical Institute of Victoria, appointed at a General Meeting, held 20th May, 1856.

MAY IT PLEASE YOUR EXCELLENCY,

During the administration of his Excellency the late Sir Charles Hotham, who was the patron of the Philosophical Institute, the Council of that body addressed him on the 17th October last, on the subject of the National Museum, to which his Excellency was pleased to return a very courteous reply, but was not at that time in a position to give a definite answer.

That no communication has since been received from Government by the Philosophical Institute, and as they have learnt that it is the intention of Government to transfer the Museum to the University, they appointed the present Committee for the purpose of directing your Excellency's attention to the serious disadvantages that would result to the public and to the cause of science from such an arrangement.

That your memorialists, being impressed with the conviction, that the great aim of a National Museum should be, to spread abroad, as widely as possible, the valuable knowledge it contains of the resources and natural history of the country we live in, and

to awaken the public taste to scientific pursuits, would beg respectfully to suggest that the first step towards accomplishing so great an ultimate object, is to place the National Museum in that locality where the public will be brought most in contact with it. The time of each individual of the general public here, is so valuable, that only a very few can afford to step so far out of their ordinary walks as the University, and even the present location of the Museum at the Assay building, although much less remote, has hitherto, your memorialists can affirm without hesitation, greatly limited its sphere of usefulness, many persons in this country remaining still ignorant of its very existence.

Your memorialists would also respectfully bring under the consideration of your Excellency, that the Philosophical Society was originally founded in connection with the National Museum, and contributed, to the utmost of its ability, towards the success of that institution, and, as the objects of the Philosophical Institute so intimately coincide with those of the National Museum, your memorialists earnestly desire that so useful a connection should continue uninterrupted. In Tasmania, such an arrangement has been found so beneficial, that the entire control of the Museum and Experimental Garden is there confided to the Royal Society.

It appears to your memorialists that the Public Library building offers great advantages for the reception of the National Museum, the lower hall being quite adequate for its present requirements. Besides its central position, the valuable stores of knowledge contained in the Library are beginning to attract the most intelligent portion of the community, and the presence of works of reference and specimens under the same roof, will materially facilitate investigation. In our mother-country, the greatest of collections, the British Museum, is in the same building with the National Library, and such a combination has been there attended with the best results.

That the Philosophical Institute being now recognised as a National Institution, your memorialists desire to embody in the present memorial a request that some room be allotted to the Society, in which its meetings may be held, and its property preserved. If accommodation could be granted them in the Public Library building, it would be most in accordance with the objects of the Society.

Your memorialists are desirous, in conclusion, of assuring your Excellency, that the well ascertained wishes of the public point to the maintenance of the National Museum as an independent institution, and one which it is hoped will soon take its rank amongst similar monuments of science in other countries, and the Philosophical Institute, as a public body, representing the scientific interests of the community, pledges itself to give it their warmest support, and to assist by every means in carrying out

the great objects which such an institution, when rendered truly national, is destined to accomplish.

The prayer of your memorialists is, therefore, that your Excellency will be pleased to direct that the National Museum, instead of being transferred to the University, be removed to the Public Library building, or to some other convenient centrally-situated position, and that a room be allotted to the Philosophical Institute, if practicable, in the Library building.

And your memorialists, as in duty bound, will ever pray.

(Signed) ARTHUR DOBREE.
S. IFFLA.
DAVID E. WILKIE, M.D.
THOMAS E. RAWLINSON.
FREDK. ACHESON.

Melbourne, 11th June, 1856.

(COPY.)

Philosophical Institute of Victoria,
Melbourne, 12th June, 1856.

SIR,

I have the honour to request that you will be pleased to ascertain when it will be convenient for his Excellency the Acting-Governor to grant an interview to the Committee of the Philosophical Institute, for the purpose of receiving their memorial on the subject of the National Museum, which document I have the honour to transmit to you herewith.

I have the honor to be,
SIR,
Your most obedient Servant,
(Signed) A. DOBREE,
Chairman of the Committee.

Address Care of Secretary of Philosophical Institute.
Capt. J. H. KAY, R.N.,
Private Secretary, &c.

(COPY.)

Private Secretary's Office,
13th June, 1856.

SIR,

In reply to your letter of the 12th instant, I am directed to inform you, that his Excellency Major-General

Macarthur will be happy to see the Committee of the Philosophical Institute, on Tuesday next, the 17th instant, at one o'clock p.m.

I have the honor to be,
Sir,
Your obedient Servant
J. H. KAY,
Private Secretary.

Arthur Dobree, Esq.

FIRST REPORT OF THE STANDING COMMITTEE on the NATIONAL MUSEUM and ACCOMMODATION FOR THE PHILOSOPHICAL INSTITUTE.

(Received at the Monthly Meeting held on the 15th July, 1856.)

Report *of the* Standing Committee *of the Philosophical Institute, appointed at a General Meeting, held* 19*th June,* 1856, *for the purpose of promoting the views of the Society on the subject of the Removal of the National Museum, and also to obtain some suitable accommodation for the Philosophical Institute.*

Mr. President and Gentlemen,

Your Committee deem it their duty, under existing circumstances, not to delay bringing before you their first Report, in order that the Institute may be made aware of the present state of the matters entrusted to the Committee.

Having decided in the first place to address the trustees of the Public Library, your Committee prepared the following memorial. (A.)

This memorial was handed to Mr. Justice Barry on 1st July, by a deputation, with a written request that his Honor would be pleased to lay it before the trustees, and, after learning all the particulars of the case, Mr. Justice Barry promised to take charge of the same. On the 4th July, the same deputation waited on the other trustees of the Library, namely, Mr. Childers, Mr. Macarthur, Mr. Stawell, and Dr. Palmer, to solicit their support of the measure. They had an interview with Mr. Childers and Mr. Macarthur, and received a very courteous note from Dr. Palmer, expressing himself favourable to the desired location of the Museum; Mr. Stawell was unavoidably absent when the deputation called. From the general feeling of the

trustees, the Committee entertained hopes that a proposal of such public utility would be favourably considered. Your Committee were informed that a meeting of the trustees of the Library was to be held on the 4th inst., and have therefore been in daily expectation of a reply to their memorial, to guide them as to their future steps. No answer has, however, been forwarded to them up to the present time.

It was therefore with considerable surprise that your Committee, a few days since, heard of the National Museum being closed, and ascertained, on inquiry, that the specimens were actually being prepared for immediate removal to the University, in pursuance of instructions received.

After the application made to Government by the Philosophical Institute, and the communication addressed to the trustees of the Public Library, your Committee must leave the meeting to form its own opinion, both upon the extraordinary proceedings adopted, without any notice to the Institute, and also upon the absence of reply from the trustees of the Library to so urgent a request as that submitted to them.

Having done everything in their power, up to the present time, for the accomplishment of the desired objects, the Committee have, under existing circumstances, the honor to await your further instructions, and beg to observe, in conclusion, that they believe a public meeting on the subject of the National Museum is in contemplation, which they have no doubt would be attended with important results, judging from the lively interest with which the views of the Philosophical Institute have universally been met.

ARTHUR DOBREE, Chairman.
DAVID E. WILKIE, M.D.
JOHN MACADAM, M.D.
THOMAS E. RAWLINSON.
S. IFFLA.
FREDK. ACHESON.

Melbourne, 15th July, 1856.

(A)

(COPY.)

To the Trustees of the Public Library of Melbourne.

The memorial of the Committee of the Philosophical Institute of Victoria, appointed at a General Meeting, held 19th June, 1856, for the purpose of promoting the views of the Society on

the subject of the removal of the National Museum, and also to obtain some suitable accommodation for the Philosophical Institute.

GENTLEMEN,

The Committee of the Philosophical Institute have the honor of addressing you, to solicit your valuable co-operation in a matter in which the public and the cause of science are deeply interested, and from the desire you have hitherto so effectually evinced for the diffusion of knowledge and advancement of science, they venture to hope that you will take a favourable view of the request about to be laid before you.

The late Philosophical Society, at its very origin, desirous of promoting the great and beneficial objects of a National Museum, framed their rules so as to give it every support in their power, and this connection has been continued by the Philosophical Institute. When last year the question of the removal of the National Museum to the University buildings was mooted, the Philosophical Institute, as a public body representing the scientific interests of the community, at once addressed his Excellency the late Sir Charles Hotham, to bring under his notice the impolicy of placing a national institution of this nature in so remote a locality.—A courteous reply was returned by his Excellency, and the matter remained in abeyance until recently, when the Philosophical Institute again learned, that the removal of the collections being imperative, the transfer to the University was about to be carried into effect. The Philosophical Institute, without delay, appointed a committee for the purpose of memorialising his Excellency the Acting-Governor on the subject, and the Committee, after urging for his Excellency's consideration, that the great aim of a National Museum was to diffuse as widely as possible the valuable information it contained, and to awaken public taste to scientific pursuits,—whereas a transfer to the University buildings would render it practically unavailable to the public, very few of whom in this place, where time is so valuable, could afford to step so far out of their ordinary walks,—recommended the selection of as central a locality as possible. They further ventured to suggest to his Excellency, that, in accordance with the successful precedent in the mother-country, it would be of great public benefit if the Museum could be placed under the same roof with the Library, because works of reference and specimens would then be brought together, and also because the Museum would then come under the notice of the most intelligent portion of the community that frequent the Library.

His Excellency, who was pleased to grant marked attention to the representations of the deputation, acknowledged the desirability of a central location for the Museum. His Excellency

stated, however, that your consent would be necessary, and that of the Council of the University, with whom, he believed, some arrangement had been entered into on this subject, during the administration of the late Governor. At the same time, his Excellency remarked that the transfer to the University was intended to be of an entirely temporary nature, as it was purposed ultimately to erect some building specially for the reception of the National Museum.

The deputation then suggested to his Excellency, that if they could obtain your concurrence to the location of the Museum for the present in the lower unoccupied hall of the Library building, its public usefulness would remain unimpaired in the interval, and its ultimate reception could be provided for by the addition of a wing to the present Library building, as soon as the new Legislature should sanction such a step. Regarding the arrangement with the University, the deputation believed that the Council of that institution, although they had expressed their willingness to take temporary charge of the Museum, when no other accommodation was available, would certainly not desire to throw any impediment in the way of so useful and publicly beneficial a measure as that now proposed.

His Excellency assured the deputation, that he would be happy to give effect to such an arrangement as would be satisfactory to all parties.

The Committee having now laid before you the details of the matter, earnestly hope that under these circumstances you will not withhold your consent to the desired arrangement, in which case they entertain the belief that no obstacle will be offered by the Council of the University.

The curator of the Museum has been referred to regarding the adequacy of the Hall for this temporary purpose, and although necessarily it does not combine every advantage, it is found very eligible as regards space and all other essentials.

As your interest in the fostering of science is so well known, the Committee deem it unnecessary further to urge the importance of their request, than to remark, that the attraction of upwards of 6,000 specimens, combined with that of your valuable volumes, would tend to increase the public interest in both institutions, and in consequence, their usefulness. The Committee having made enquiries as to the opinion of the general public on the subject, can confidently testify to the universal wish to see so desirable a project carried into effect.

On the subject of the desired accommodation for the Philosophical Institute, the deputation brought that matter also under the notice of his Excellency, stating that accommodation in the Public Library would be most desirable, if your consent could be obtained. His Excellency expressed the pleasure it would afford

him if such an arrangement could be made, and was pleased to request Captain Clarke to communicate with you. The Committee have now the honour of bringing this matter before you, and trust you will take it into your favourable consideration.

We have the honour to remain,

GENTLEMEN,

Your most obedient Servants,

(Signed) ARTHUR DOBREE.
J. MACADAM, M.D.
F. ACHESON.
T. E. RAWLINSON.
S. IFFLA.
D. E. WILKIE, M.D.

Melbourne, 1st July 1856.

(COPY.)

To his Honor Mr. Justice Barry, &c. &c.

SIR,

Referring to a recent interview with his Excellency the Acting-Governor, at which the Committee of the Philosophical Institute recommended the location of the National Museum in the Public Library building, and also submitted the request that some accommodation might there be afforded to the Philosophical Institute,—to which arrangement his Excellency in reply stated, that the assent of the trustees of the Library would be requisite, —the Committee of the Philosophical Institute now venture, in reliance on your Honor's well-known zeal in affairs connected with science, to solicit your valuable co-operation in these matters, and respectfully to pray that your Honor will be pleased to take charge of their annexed address to the trustees of the Public Library on these subjects.

We have the honour to remain,

Your most obedient Servants,

(Signed)

On behalf of the Committee of the Philosophical Institute. { ARTHUR DOBREE. J. MACADAM, M.D. D. E. WILKIE, M.D.

Melbourne, 1st July, 1856.

(COPY.)

July 3rd, 1856.

SIR,

I regret that I cannot appoint a time for meeting the deputation, but I have expressed my opinion to Mr. Justice Barry,

that so far as is consistent with the pledge of the Government, I consider it would be more for the public advantage, that the general Museum should be under the same roof as the general Library. I am, Sir,

Your obedient Servant,

J. F. PALMER.

Arthur Dobree, Esq.

SECOND REPORT OF THE STANDING COMMITTEE OF THE PHILOSOPHICAL INSTITUTE OF VICTORIA, ON THE SUBJECT OF THE NATIONAL MUSEUM.

(Received at the Monthly Meeting held on the 19th of August, 1856.)

Second Report *of the* Museum Committee *of the Philosophical Institute of Victoria, appointed at a General Meeting, held* 19*th June,* 1856.

Mr. President and Gentlemen,

In accordance with the instructions received at the last General Meeting of the Institute, your Committee have laid before the public the question of a National Museum, at a public meeting held on the 26th July last, in the Hall of the Mechanics' Institution, and your Committee have much pleasure in reporting the strong expression of public interest elicited on that occasion. The press having given full details of the meeting, your Committee deem it only necessary to annex the reports of the *Argus, Age,* and *Herald* newspapers. (See papers of 28th July, 1856. For Resolutions passed, see Appendix.)

The immediate result of the meeting was the appointment of a Committee, to lay before the Acting-Governor the resolutions adopted; and the report of their interview with his Excellency will be found annexed, as it appeared in the *Argus* newspaper. (See Appendix.)

Your Committee regret to inform you, that while the arrangements for convening the public meeting on the subject were pending, the collections were hastily removed from the Assay buildings to the University, where they at present remain.

Your Committee, nevertheless, find ample ground for congratulation, in having obtained the following results:—

1st,—That public attention has been directed to the subject, and a very strong desire has been proved to exist for the speedy establishment of a truly national Museum.

2ndly,—That a distinct statement has been elicited from the Government, to the effect, that the removal to the University has been allowed only as a temporary expedient, and is only to be regarded as such,—as the specimens are to be returned, as soon as convenient accommodation elsewhere is provided.

3rdly,—That the Government have stated that, after the assembling of the new Legislature, they will be disposed to promote the views set forth in the resolutions of the meeting, with reference to providing a central and suitable building for the National Museum.

Your Committee will continue zealously to watch over the progress of this matter, and not lose sight of the important subject confided to their care. It is necessary to state that throughout all their proceedings, your Committee have endeavoured to act in the same spirit as that in which you appointed them, namely, upon the broad basis of public expediency, and for the cause of science, totally irrespective of any other considerations.

In the construction of your Committee, some change has taken place. They regret having lost the services of Mr. F. Acheson, the pressure of his business engagements not allowing him the necessary time to devote to the duties of the Committee. Mr. Dobree has latterly been compelled to resign the office of Chairman from the same cause, but still continues a member of the Committee. Dr. Macadam was nominated by Mr. Dobree as his successor, and unanimously elected.

JOHN MACADAM, M.D., Chairman.
ARTHUR DOBREE.
THOMAS E. RAWLINSON.
DAVID E. WILKIE, M.D.
S. IFFLA.

Melbourne, 19th August, 1856.

REPORTS OF MONTHLY MEETINGS.

2nd August, 1855.

Dr. Iffla in the Chair.

The minutes of the last meeting were read and confirmed.

Frederick Acheson, Esq., presented to the chairman a letter from Mr. R. Brough Smyth, requesting not to be put on the nomination of candidates for the office of honorary secretary.

It was proposed by William Blandowski, Esq., seconded by the Rev. Dr. Goethe, and carried,—

That R. Brough Smyth and W. S. Gibbons, Esqrs., be elected members of council in consideration of the valuable services rendered by them to the Institute.

R. Brough Smyth and W. S. Gibbons, Esqrs., having declined the candidateship, it was moved by Frederick Acheson, Esq., seconded by Ludwig Becker, Esq., and carried,—

That S. Wekey, Esq., be re-elected as honorary secretary to the Philosophical Institute.

The acting honorary secretary was instructed to intimate to

Mr. Wekey his re-election to the office, and to request him to resume his duties as honorary secretary.

On the motion of William Blandowski, Esq., seconded by Ludwig Becker, Esq., it was resolved,—

"That the subscriptions due to the end of the present year, be "required to be paid by the 1st day of October next, and that the "names of such members as shall not have paid their subscriptions "by that time be erased from the roll of the Philosophical Institute."

Dr. Maund presented a letter to the chairman from Mr. Kentish concerning the Perpetual Motion, when,

It was moved by F. Acheson, Esq., seconded by the Rev. Dr. Goethe, and carried,—

"That the consideration of Mr. Kentish's letter be postponed till "this day six months."

Mr. Gibbons proposed the discussion of the paper, which was seconded by Dr. Wilkie, but the motion was lost.

Dr. Wilkie, for the Rev. A. Morison, complained, in the name of several other clergymen, of the high subscription fee of the Society, viz., three guineas, and expressed their desire to become members if it were reduced to one guinea.

The Rev. Dr. Goethe observed that it was highly desirable the Institute should secure the co-operation of clergymen; but he considered that the three guineas subscription was too high for all, and he was therefore in favour of the reduction.

Dr. Eades stated that a resolution had been already made in Council, fixing the subscription for new members at two guineas.

Thanks being voted to the chairman, the meeting adjourned.

7th September, 1855.

Monthly Meeting.

D. E. Wilkie, Esq., M.D., in the Chair.

The minutes of the last meeting having been read, Mr. S. Wekey, the honorary secretary, stated that he regretted being obliged to express his opinion respecting a resolution passed at the last meeting, and having reference to the formation of two new offices in the Council, without previous notice having been given to members to that effect. He congratulated the gentlemen who had been invited to fill the new offices, and he would have been happy to have voted in support of the resolutions; but he entirely disapproved of the mode by which the result had been arrived at, as establishing a dangerous precedent, which, if acted upon, would tend to the disorganization of any society. The last meeting was convened for the purpose of electing an honorary secretary in place of the secretaries resigned, and due notice was given to members to that effect. But as there was no

notice given that two new offices would be formed, the meeting had no right whatever to entertain the question. He was satisfied that the mover of this resolution, Mr. Blandowski, was actuated by a generous feeling in proposing the resolution referred to, but he could not possibly believe that there was any member of the Institute who would be in favour of establishing a precedent that might prove the source of future irregularities in the management of the affairs of the society. Moreover, the gentlemen to whom this mark of distinction was offered, might feel offended should they know that such distinction was conferred on them in an irregular way, in which, therefore, it could not be very gratifying to them. He wished that this meeting should remedy the mistake, and he therefore begged to move,—

"That the portion of minutes of the last meeting having reference to the formation of two new offices in council be not confirmed, as there was no previous notice given to members to that effect, and that the mover of the said resolution give notice of such motion regarding the subject in question as he may deem proper; his motion to be decided upon at the next monthly meeting of the Society."

Mr. Blandowski then withdrew his motion, and gave notice of his intention to move at the next meeting,—

"That three members of council be elected, and that the candidates to such office be Professors McCoy and Wilson, of the University, R. Brough Smyth, W. S. Gibbons, and Clement Hodgkinson, Esqrs."

Dr. Maund wished to know whether the subscription of new members was fixed at two guineas?

The honorary secretary said that the subscription for new members was fixed by the council to be two guineas per annum, but he thought that the last meeting had no power to set aside the fundamental rules of the society, as clearly expressed in the report adopted by both the late societies, being now the bye-laws and regulations of the Philosophical Institute.

F. Sinnett, Esq., said he understood that the council had fixed the subscription for new members at two guineas per annum.

The questionable paragraph in the minutes of the last monthly meeting having been settled by the withdrawal of Mr. Blandowski's motion, the remaining portions of the minutes were then confirmed.

The honorary secretary announced the election of Edward Cohen, Esq., resident member, and James Kilgour, Esq., M.D., of Geelong, corresponding member of the Institute.

Ludwig Becker, Esq., read a paper, illustrated by diagrams, descriptive of two viviparous fishes from Hobson's Bay; one of them being characterized by a pouch; and in conclusion remarked

that, although he believed that naturalists were not unaware of the existence of *Marsupials* among fishes, he thought the specimen furnished by him was a new species.

Mr. Blandowski thought that the fishes described by Mr. Becker were not new discoveries, but were already known.

A discussion on the paper then ensued, in which several of the members took part, and ended by Mr. Blandowski promising to write another paper on the fish described by Mr. Becker, and to lay it before the next meeting of the Institute.

James Kilgour, Esq., M.D., then read a paper on "Sleep and "Dreams."

23rd October 1855.

MONTHLY MEETING.

David E. Wilkie, Esq., M.D., in the Chair.

The minutes of last meeting were read and confirmed.

W. Blandowski, Esq., in accordance with his promise made at the last meeting, read his "Observations on the paper of Ludwig "Becker, Esq., read at the previous meeting of the Institute, and "in which the term of '*Marsupial Fishes*' is made use of by the "Author."

Ludwig Becker, Esq., read a paper "On the age of the Animal "and Vegetable Kingdoms of Australia, relatively to that of the "rest of the world, and some remarks on the changes of this land "by upheavals."

The Honorary Secretary read the revised constitution of the Institute, prepared by the Council, and submitted to the meeting for adoption.

It was moved by Arthur Dobree, Esq., seconded by Ludwig Becker, Esq., and carried,—

"That the adoption of the constitution of the Institute be postponed to the next meeting, and that the Secretary forward copies of same to the members previous to the next monthly meeting of the Institute."

W. Blandowski, Esq., exhibited Photographs of "Dryden's Monument," near Mount Macedon, and lithographs of Silurian fossils from Johnson's Creek.

Presents acknowledged:—A White Opossum, by Edward Wilson, Esq.; specimens of Auriferous Copper Ore from the Steiglitz diggings, recently discovered near Geelong, by William Paterson, Esq.; the nest and eggs of the Blue Wren and White-shafted Fantail, by Arthur Dobree, Esq.; a very destructive species of Caterpillar, by Miss Perry; the eggs of Cocculus Inornatus, by W. Blandowski, Esq.

28th November, 1855.

MONTHLY MEETING.

The President in the Chair.

The minutes of the last meeting were read and confirmed.

Professor Hearn, of the University, was announced to have been elected a member of the Institute.

Communications were read by the secretary, from the Royal Society of Tasmania, and the Adelaide Philosophical Society, acknowledging the receipt of copies of the Transactions of the Philosophical Society, and forwarding copies of their publication.

A letter from J. T. Charlton, Esq., of Welchpool, was read, with a description of a poisonous fish forwarded through the Rev. A. Morison.

R. Eades, Esq., M.B., on behalf of Dr. Maund, read the result of his analysis of a specimen of auriferous ore from the Steiglitz diggings forwarded to the society by William Paterson, Esq., of Geelong.

In reference to the new constitution of the Institute, submitted to the meeting for adoption—It was moved by W. Clarson, Esq., seconded by W. S. Gibbons, Esq., and carried—

"That the consideration of the rules and regulations be postponed "to the next meeting, and that the secretary be instructed to for- "ward copies of the same to all the members."

It was moved by Dr. D. E. Wilkie, seconded by Dr. R. Eades, and carried,—

"That whereas it appears that there were no funds to enable "the Philosophical Society to publish their Transactions, and that "one of their secretaries, Mr. Wekey, from a laudable desire to for- "ward the interests of the society, undertook the responsibility of "publishing them by private subscription, and without any cost to "the members. And whereas, from various causes, he has been "deceived in his just expectations of success, and has incurred a "debt of £180 for publishing the same. This Institute hereby "resolves to adopt this debt as a debt of the Institute, to be de- "frayed out of the funds, so soon as there shall be an available "surplus for that purpose."

It was moved by Dr. D. E. Wilkie, seconded by F. Acheson, Esq., and carried, —

"That whereas the Transactions of the late Philosophical "Society have not been published at the cost of that Society, while "each member of that body, as well as of this Institute, has been "furnished with a copy of the same: it is resolved that each mem- "ber of the late Philosophical Society, as well as of the Institute, "be charged with the sum of one guinea (which is the publishing

" price of the Transactions) for the purpose of defraying a portion " of the debt incurred.",

It was moved by Dr. Black, seconded by Dr. Eades,—

" That the balance-sheet of the late Philosophical Society be " audited."

Ludwig Becker, Esq., gave notice that, at the next meeting of the Institute, he would move for a printed list of members, revision of the rules, and nomination of office-bearers.

31*st December*, 1855.

Monthly Meeting.

A. K. Smith, Esq., C.E., in the Chair.

The minutes of the last meeting were read and confirmed.

On the motion of Dr. S. Iffla, seconded by W. Blandowski, Esq., it was resolved,—

" That on account of the sudden death of his Excellency the " late Governor, who was the patron of the Society, this meeting " deems it proper to adjourn till Monday, the 7th January next."

7*th January*, 1856.

Adjourned Monthly Meeting.

Professor Wilson in the Chair.

The minutes of the last meeting were read and confirmed.

It was moved by R. Brough Smyth, Esq., seconded by Dr. D. E. Wilkie,—

" That Mr. Becker's motion be considered prior to the reading " of the new constitution of the Institute."

It was moved, as an amendment, by Dr. Maund, seconded by Dr. S. Iffla,—

" That this meeting proceed to the consideration of the rules."

The amendment was carried.

The new constitution of the Institute was gone through *seriatim*, and the following rules were adopted :—*

The Secretary read the following communication from Wm. Adeney, Esq., forwarded to the Institute by Dr. Howitt, and bearing upon the discovery of fossil remains in Victoria, of the Thylacoles, or Marsupial Lion.

Chocolyn, Timboon, 13th August, 1855.

Dear Doctor Howitt,

I send you the following copy of a note received from Professor Owen, thinking it may interest you, and if you think it

* See printed rules of the Ph. Inst. of Vic.

right, I will thank you to send this to the secretary of the Philosophical Society of Melbourne, whose name I do not know. The note is in reply to a letter addressed to the Professor by myself, inquiring the fate of some specimens of fossil bones sent to him by me through the late Dr. Hobson.

(COPY.)

Royal College of Surgeons, London,
April 18th, 1855.

SIR,

Yours of the 25th December, 1854, has just come to hand. I had no difficulty in recognising the fossil transmitted by Dr. Hobson, through the indication you have given. It consists of two portions of the skull of the Thylacoles, or Marsupial Lion, a very rare and remarkable fossil. It was acknowledged in due course, as I believe, to my lamented and amiable friend. I think the fossil tooth, which Mr. Stuckbury has described under the name of Rhizodon, belongs to the same extinct carnivorous animal. I am glad to know to whom science is indebted for the discovery of the fossil sent me by Dr. H., and I shall feel gratified by receiving any particulars of the circumstances under which it was discovered ; and I beg to add, that should you favor me with any other fossil specimens, your kindness will be duly acknowledged in my description of them.

Believe me, &c.,

RICHARD OWEN.

WILLIAM ADENEY, Esq.,
Chocolyn, Timboon, Victoria.

The secretary presented the following list of persons whom the Council nominate as suitable to hold the offices of President, Vice-Presidents, and Members of Council respectively, viz. :—

President—Andrew Clarke, Capt. R.E., Surveyor-General, &c. &c.

Vice-Presidents—Professor Wilson and Clement Hodgkinson, Esq., C.E.

Members of Council—Dr. S. Iffla, Frederick Sinnett, A. K. Smith, C.E., Dr. R. Eades, Wm. Blandowski, S. Wekey, Capt. Pasley, R.E., W. S. Gibbons, Dr. John Maund, Professor M'Coy, M. B. Jackson, C.E., Dr. D. E. Wilkie, the Rev. A. Morison, and R. B. Smyth.

The following persons were added to the list by the meeting, viz. :—

For Vice-Presidents—Mr. Justice Barry, Dr. Godfrey Howitt, Major Norman Campbell.

For Members of Council—Robt. H. Bland, W. H. Archer,

Ludwig Becker, Professor Hearn, Dr. J. Black, Dr. William M'Crae, Frederick Acheson, and H. Selwyn.

Dr. J. Maund, in the absence of Mr. Gibbons, moved—

That the vote passed at the November meeting, in adopting the debt of the Philosophical Society, be rescinded.

Mr. Brisbane seconded the motion, which, being put from the chair, was lost by a majority of ten to two.

The following presents were received and acknowledged :—

A specimen of Kaolin, from Bulla, near the Deep Creek, and Crystals of Zinc, by R. B. Smyth, Esq. Specimens of Auriferous Rocks, by S. Wekey, Esq.

February 4th, 1856.

First Annual Meeting.

The President in the Chair.

The minutes of the last meeting were read and confirmed.

The President introduced the Rev. John J. Bleasdale as a new member of the Institute.

First Report of the Council of the Philosophical Institute of Victoria, presented to the members at the first annual meeting of the Institute.

The Philosophical Institute, as you are all aware, has been established by the incorporated Union of the Victorian Institute and the Philosophical Society; and, in presenting their first annual report, the council have to congratulate you on this auspicious event.

The terms of Union are embodied in the Report which was agreed upon by a joint committee of members of both societies, and which has since been published in the Transactions.

From the time of the adoption of the above-mentioned report, in July, 1855, by a general meeting of members of both societies, is dated the establishment of the Philosophical Institute of Victoria.

The Council do not consider it within their province on the present occasion to review the proceedings of either of the two societies now happily blended.

These societies were originated about the same time and had the same objects in view, viz., the cultivation of science. Hence, it was obviously most desirable that they should merge all minor differences, and unite with the grand object of associating in one society all the cultivators of science in Victoria, and of founding a national institution for its advancement.

Similar societies in the mother-country and on the continent of Europe have long enjoyed the confidence of the public, the patronage of royalty, and ample pecuniary assistance from the state.

From the well-known liberality of the Legislative Council of Victoria, there is strong encouragement to hope that they will confer such solid advantages upon this Institute as will enable it to develop the objects it has in view.

In the prospect of such aid, we may look forward to the time when the Institute shall have a building of its own, in which to hold its meetings, and to keep its library and museum.

By annually publishing their Transactions, the Institute may hope to correspond with kindred institutions in all parts of the world, and in return for their Transactions, to receive those of other societies. In this way it is hoped that we may very soon be enabled to form the nucleus of a valuable scientific library.

The Philosophical Society was instituted in connection with the Museum of Natural History in this city, and it formed an important feature in its constitution to advance and extend the museum as far as its limited means would admit, and your Council is most desirous that the Institute should be recognised by the Government as the guardians and trustees of this museum.

Some months since, it was rumoured that it was in contemplation to remove the Museum to the University, and the Council therefore considered it to be their duty to address a letter to his late Excellency Sir Charles Hotham on the subject, to which he replied in the most courteous manner, that, in the absence of Capt. Clarke, the Surveyor-General, he could not arrive at any decision respecting the museum, but that, on that officer's return to Melbourne, he would communicate with him on the subject of our letter.

The Council would press on the Institute the great importance of taking further steps in this matter.

The Museum of Natural History in Hobart Town is placed under the guardianship of the Royal Society of Van Diemen's Land. This society enjoys a large annual grant from the public funds, and through the kind patronage of the Government they have also obtained a valuable grant of land, which is devoted to the purposes of an experimental garden.

The successful establishment and liberal endowment of the Royal Society of Van Diemen's Land, may encourage us to hope for similar favors and similar patronage here. If we honorably exert ourselves in forwarding the great objects of our institution, and if we succeed in showing that our labors will really contribute to the welfare of the colony, we may rest assured that they will not fail to be recognised and rewarded.

The first duty that devolved upon the affiliated societies was to frame rules and regulations for the government of the Institute, and the Council are happy to report, after bestowing much care on and attention to this subject, they were enabled, at the last gene-

ral meeting of the Institute, to submit a code of rules, which was then finally adopted, and which it is hoped will prove efficient in the working of the society.

The Council regret that they cannot present a very favorable report of the financial condition of the Institute.

At the amalgamation of the two societies the funds of each were exhausted in their current expenses, and in the publication of their Transactions. All the available funds of the Philosophical Society had been expended in the publication of their Transactions for 1854, and it was therefore attempted, by a private arrangement, and independent altogether of the funds of the Society, to publish Transactions for 1855. It was confidently expected by Mr. Wekey, who was at the time one of the secretaries of the Philosophical Society, and who had undertaken this publication at his own risk, that the sale of the Transactions would defray the costs.

Several months after the amalgamation of the societies, it appeared, for the first time, that a debt of £180 had been thereby incurred, and that Mr. Wekey's arrangements for liquidating the same had failed. It was under such circumstances that the Philosophical Institute resolved to adopt this debt.

Having stated Mr. Wekey's connection with the debt thus adopted by the Institute, it is only justice to him to add, that in return for the liabilities thus incurred, upwards of two hundred and thirty copies of the Transactions of the Philosophical Society have been distributed among the members of the Institute, and have been forwarded to other scientific societies. It is also due to the Victorian Institute to state, that at the time of the Union they were perfectly free from debt, and it is much to be regretted that the financial affairs of the Philosophical Society, as above explained, were not in an equally satisfactory condition.

In closing this report, the Council have only further to add, that in accordance with the rules, a list of office-bearers for the ensuing year was submitted to the last general meeting, and it now devolves upon you to proceed to the appointment of our successors.

In retiring from office the Council would earnestly impress upon the members the deep necessity of co-operation, and they venture to hope that by our united efforts in the cause of science, we shall succeed in placing our infant society upon a respectable footing, and securing for it public approbation and confidence.

On the motion of Dr. D. E. Wilkie, seconded by Dr. S. Iffla, the report was adopted.

Dr. S. Iffla and R. Brough Smith were appointed scrutineers, and the meeting proceeded to the election of office-bearers for the current year.

The scrutineers reported the following result of the ballot taken.

President, Captain Clarke, R.E., Surveyor-General.

Vice-Presidents : Professor Wilson, Clement Hodgkinson, Esq., C.E.

Council : Dr. S. Iffla, William Blandowski, Esq., Professor McCoy, Dr. D. E. Wilkie, the Rev. A. Morison, R. Brough Smyth, Esq., Ludwig Becker, Esq., Professor Hearn, A. Selwyn, Esq., W. H. Archer, Esq., Captain Pasley, R.E., and A. K. Smith, Esq.

Treasurer, Dr. D. E. Wilkie. Secretary, S. Wekey, Esq.

The President delivered an anniversary address to the Institute.

F. Acheson, Esq., C.E., read a paper " On a proposed floating Railway Pier applicable to Hobson's Bay."

After a vote of thanks to the President for his valuable services in connection with the Institute, the meeting separated.

25th February, 1856.

MONTHLY MEETING.

Professor Wilson in the Chair.

In the absence of the Secretary, Mr Acheson read the minutes of the previous meeting, and afterwards adverted to certain serious discrepancies between the list of votes for members of Council taken at that meeting, and the scrutineers' report, whereby it appeared that Captain Pasley's name was omitted although duly elected, and Mr. Selwyn's votes were reported 12 instead of 11, which error placed him out of the subsequent re-election that took place of those having 11 votes. He (Mr A.) alluded to the importance of having the Council legally elected, as they would have the disposal of a Government grant. After much discussion on the subject—

It was moved by Mr. Acheson, seconded by Dr. Wilkie, and carried—

" That the minutes of the previous meeting be confirmed with " the addition of Captain Pasley's name on the list of Council " Members."

A balance sheet was then read, as audited by Professor Wilson and W. H. Archer, Esq., showing the receipts and expenditure of the Philosophical Society from its formation in July, 1854, to the amalgamation in June, 1855 ; and also the receipts and expenditure of the Philosophical Institute, from the amalgamation in June to the 31st of December, 1855.

It was moved by T. E. Rawlinson, Esq., seconded by W. Blandowski, Esq.,—

" That the balance sheet now presented be published."

An amendment was moved by Dr. Wilkie, and seconded by Arthur Dobree, Esq.,—

"That the balance sheet should lie over for further considera-
"tion."

The amendment was carried.

Mr. Blandowski then read a paper entitled "Observations in "Western Port during an excursion from King's Station to Bass' "River, Phillip and French Islands."

In the absence of Mr. Smyth, Professor Hearn laid on the table descriptions of a "Land and Marine Iron Barometer," and of a "proposed Victorian Telescope," invented by Peter Robertson, Esq., of the Registrar General's Office.

19*th March*, 1856.

MONTHLY MEETING.

Professor Wilson in the Chair.

The minutes of the last meeting were read and confirmed.

Dr. Jacobs, Henry Edwards, and — Kershaw, Esqs., were announced to the meeting as having been elected members of the Institute, and Mr Kershaw was introduced by the Chairman.

Copies of the *Government Gazette* from the 1st January, 1856, and a copy of the Statistical Register of Victoria, were laid upon the table, having been presented to the Institute by command of His Excellency the Officer administering the Government, and it was stated that the *Government Gazette* would in future be regularly supplied.

Present acknowledged. Specimen of Barnacles, from the hull of the "*Thomas and Ann Cole*" presented by G. Teale, Esq., of William-street, Melbourne.

J. Braché, Esq., C.E., furnished a paper, which was read by the Acting Honorary Secretary, entitled "Observations on the "present and future prospects of the Auriferous Mines of Victoria, "their influence on civilization, and a comparison between the "methods of extracting and working employed in Australia and "California."

The paper was listened to with great attention.

R. Brough Smyth, Esq., the Acting Honorary Secretary, laid before the meeting a report on the Meteorology of Melbourne, illustrated by diagrams of atmospheric pressure, for the eight months ending January 31st, 1856. Extracts were read by Mr. Smyth, illustrative of the diagrams.

It was moved by Ludwig Becker, Esq., seconded by R. Brough Smyth, Esq., and carried—

"That in the opinion of this meeting it is desirable that the "Transactions for the period ending December 31st, 1855, be "printed and published as soon as possible."

It was moved by Dr. Iffla, seconded by R. Brough Smyth, Esq., and carried—

"That in carrying out the publication of the Transactions the "Council be instructed not to incur any debt in excess of funds "in hand."

Ludwig Becker, Esq., asked whether it was the intention of the Institute to devote the Government grant solely to the publication of the papers and proceedings that have accumulated since the amalgamation of the two societies.

The Acting Honorary Secretary stated in reply, that he hoped no portion of the Government grant would be employed in paying any old debts of the Institute. Already members of the Institute, and many members of the late Victorian Institute, had volunteered to contribute most handsomely towards defraying the old debts.

On the motion of Dr. Wilkie, seconded by Ludwig Becker, Esq., it was decided to hold the monthly meetings on Tuesday evenings.

Mr. Braché gave notice of his intention to move at next meeting for the appointment of a commission to enquire into the best methods of conducting auriferous mining operations. He thought such a project might accomplish much good, and be the means of obtaining the countenance and support of the Legislature in carrying out the objects for which the Institute was founded.

15*th April*, 1856.

Monthly Meeting.

The President in the Chair.

The minutes of the last meeting were read and confirmed.

The Chairman announced the election of the Rev. Wm. Baxter.

Clement Hodgkinson, Esq., C.E., Vice-President of the Institute, read extracts from his report on the natural features of the basin of the River Murray.

The Acting Honorary Secretary read extracts from the official report of the Government Geologist, A. R. C. Selwyn, Esq., on the geological structure of that part of the colony of Victoria comprised in the basin of the river Yarra Yarra, and part of the northern, north-eastern, and eastern drainage of Western Port Bay, illustrated by geological maps and sections.

While the papers were being read, the distinguished explorer, Captain Cadell, entered the room, and was introduced to the meeting by the Chairman.

J. Braché, Esq., civil and mining engineer, in accordance with the notice given at last meeting, moved—

"That a commission be appointed to collect information concern- "ing the present methods of working auriferous alluvial deposits "and quartz veins,—to offer suggestions as to the best methods of "aiding the gold miner in his pursuit, and generally to discuss the "question of mining as practised in this colony."

Mr Braché spoke in support of the motion, and the Acting Honorary secretary seconded; when Mr Braché moved, contingent to his first motion being agreed to, that the commission do consist of the following gentlemen :—

The Honorable Captain Clarke, R.E., Clement Hodgkinson, Esq., C.E., Professor Wilson, Professor Hearn, Professor McCoy, R. Brough Smyth, Esq., C.E., A. R. C. Selwyn, Esq., Government Geologist, William Blandowski, Esq., Frederick Sinnett, Esq., and the mover.

The Chairman spoke in favor of the motion, which was carried.

William Blandowski, Esq., then read his paper entitled, "Report on an excursion to Frankston, Balcombe's Creek, Mount Martha, Port Phillip Heads, and Cape Schank," with illustrations, lithographs of fossils, &c.

A discussion ensued, in which Professor McCoy, Mr. Braché, and Mr. Blandowski, took the chief part.

It was moved by Ludwig Becker, Esq., seconded by the Acting Honorary Secretary, and agreed to,—

"That the Institute do take into consideration the utility and practicability of introducing the Camel and other useful animals into the Australian Colonies. And that a commission be appointed, to consist of Professor M'Coy, Professor Wilson, Dr. Iffla, Clement Hodgkinson, Esq., R. Brough Smyth, Esq., and the mover."

A discussion of great interest ensued, in which the President, Captain Cadell, Professor McCoy, and Mr Braché, took the chief part.

Mr. Dobree gave notice that at the next meeting he should move,—

"That discussion be invited on the subject of the Museum of Natural History, and with the approval of the Society a committee be appointed to frame a petition to His Excellency the Acting Governor, praying that the Museum, instead of being removed to the University buildings, be transferred to the unoccupied portion of the Public Library building, and also that a room be there placed at the disposal of the Institute."

Dr. Wilkie gave notice that at the next meeting he should move,—

"That the Institute do take into consideration their financial condition, with a view to the liquidation of all their existing liabilities."

On the motion of Professor Wilson, votes of thanks were passed to the gentlemen who had read papers, and who had permitted specimens to be exhibited.

Specimens exhibited.—Rocks and Fossils of a highly interesting character from the basin of the Murray; and specimens of highly Auriferous Quartz from the range between Anderson's Creek and Thomson's Gully, 15 miles from Melbourne, by C. Hodgkinson,

Esq. The acting Honorary Secretary exhibited some Minerals from the Brisbane Ranges, and Ludwig Becker, Esq., a specimen of a luminous Fungus.

20th May, 1856.

MONTHLY MEETING.

Clement Hodgkinson, Esq., C.E., Vice-President, in the Chair.

The minutes of last meeting were read and confirmed.

The Chairman announced the election of the following gentlemen,—

Mungo Park Smith, Esq., Alfred J. Agg, Esq., Charles R. Swyer, Esq., The Rev. C. P. M. Bardson, F. B. Franklyn, Esq., Thomas J. Laby, Esq., Dr. Gillbee, Dr. Llewellyn.

A paper by F. C. Christy, Esq., C.E., was read by the Acting Honorary Secretary, on "Improving Land by Irrigation."

A long and very interesting discussion ensued, in which Mr. Rawlinson, Mr. Becker, and others took a share, when Professor Wilson spoke on the subject, and pointed out the great necessity of an enquiry into the whole question. Owing to its high importance to the agricultural and mining interests of the country he moved that a commission be appointed to consider the question of Irrigation in its economical, meteorological, and engineering bearings. The commission to consist of—

F. C. Christy, Esq., Clement Hodgkinson, Esq., T. E. Rawlinson, Esq., George Holmes, Esq., Professor Hearn, R. Brough Smyth, Esq., J. Braché, Esq., and Professor Wilson.

The motion was seconded by T. E. Rawlinson, Esq., and carried.

The Acting Honorary Secretary then read extracts from a report by C. Mayes, Esq., on the Ancient Flood-marks of the River Murray.

A discussion ensued on the navigation of this river, which drew forth from the Chairman, Clement Hodgkinson, Esq., a great many new and important facts which he had collected during his visit of inspection. He particularly alluded to the improvements of the river for the purposes of navigation, and pointed out in what manner such improvements could be best effected.

Mr. Blandowski, Mr. Holmes, Dr. Wilkie, and others, took a prominent part in the subsequent discussion.

In accordance with a previous notice, Mr. Dobree then brought forward his motion on the subject of the removal of the Museum.

He moved first,—"That discussion be invited on the subject of "the Museum of Natural History, and with the approval of the "Society a committee be appointed to frame a petition to His "Excellency the acting Governor, praying that the Museum, instead "of being removed to the College buildings, be transferred to the

" unoccupied lower portion of the Public Library buildings; and " also that a room be there placed at the Society's disposal."

Mr. Dobree read a very able and interesting paper in support of his views, when the motion being seconded by T. Rawlinson, Esq.,

Professor Hearn rose and pointed out that this question had been already settled by the Legislature, that further agitation would be useless and unprofitable. He then alluded to the advantages that would accrue to science from this Institution being in connection with the University, but distinctly disclaimed any desire to thwart the wishes of the Melbourne public, for whose benefit the Institution was devised.

He therefore moved as an amendment, " That the meeting do " proceed to the next motion on the paper," which was seconded by the Acting Honorary Secretary.

The original motion was carried.

Mr. Dobree then moved, " That a committee, (Dr. Iffla, Mr. " Rawlinson, Mr. Dobree, Mr. Acheson, and Dr. Wilkie,) be ap- " pointed to take the necessary steps involved in this motion."

It was seconded by Dr. Wilke, and carried.

In accordance with previous notice, Dr. Wilkie brought forward his financial scheme, which, briefly, consists in the establishment of " Life Memberships." It was warmly applauded by the meeting, many gentlemen expressing their willingness to avail themselves of the privilege of becoming Life-members. He was instructed to bring the scheme before the Council.

The Acting Honorary Secretary gave notice that he would move at the next monthly meeting, that the Rev. Dr. Scoresby be elected an Honorary Fellow of the Philosophical Institute.

19*th June*, 1856.

SPECIAL GENERAL MEETING.

Professor Wilson, Vice-President, in the chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were elected members of the Institute :—George Teale, Esq., Colin Campbell, Esq., M.L.C., Rev. Richard Fletcher, St. Kilda, James Blackburn, Esq., architect, Richmond.

The report of the Committee on the petition of the Institute, praying His Excellency the Acting Governor, " that the Museum " of Natural History be removed to the Public Library instead of " the University," was read by Mr. Dobree.

A. K. Smith, Esq., moved the adoption of the report, which was seconded by Mr. Glasson, and received with unanimous approval.

A lively discussion ensued between Dr. Eades, Dr. Macadam,

Dr. Wilkie, Mr. Dobree, and others, on behalf of, and Professor McCoy against, the petition.

It was moved by Dr. Iffla, seconded by Dr. Wilkie, and carried, —"That a standing committee be appointed to watch over the "progress of the enquiry concerning the removal of the Museum."

Dr. Iffla moved "That the former committee appointed to "present the petition to His Excellency do constitute the pro- "posed committee, with the addition of Dr. Macadam." Dr. Wilkie seconded the motion, and it was unanimously carried.

Professor Hearn proposed, "That Dr. Scoresby be elected an Honorary Fellow of the Institute." The proposal was seconded by Dr. Eades, and carried with much applause.

Professor Hearn then read a paper "On the formation of Primary "Schools in Victoria." At the conclusion a warm discussion took place, in which Colin Campbell, Esq., Dr. Iffla, the Rev. Dr. Goethe, Dr. Eades, and others, actively joined.

On the motion of Dr. Mackenna, seconded by the Rev. A. Morison, a vote of thanks was passed to Professor Hearn for his interesting and valuable paper.

The Rev. A. Morison expressed a wish, on behalf of that portion of the community interested in the subject treated of, that Professor Hearn would be prevailed upon to publish his paper for the benefit of the public.

The Chairman announced the resignation of the Honorary Secretary, S. Wekey, Esq., and read the official letter of resignation. At the conclusion the Chairman mentioned the fact that no provision had been made in the rules of the Institute in case of resignation of the Honorary Secretary. Before the resignation of Mr. Wekey be accepted, it was therefore necessary to frame some law to provide against this contingency.

It was hereon agreed that the Honorary Secretary should be, *ex officio*, Member of Council.

It was moved by Dr. Wilkie, seconded by Mr. Dobree, and carried; that the resignation of Mr. Wekey be accepted, and that a vote of thanks be given to that gentleman for his most valuable services to the Institute.

The proposal of Dr. Wilkie, seconded by Dr. Iffla, "That the meeting be adjourned owing to the late hour of the night," was lost.

Professor Hearn moved, and Mr. Glasson seconded, "That the meeting proceed to the next business," which was accordingly resolved upon.

The Vice-President proposed that the alteration of the rules concerning the election of corresponding, ordinary, and honorary members be proceeded with.

Certain amendments were then agreed to, which are :—

ALTERATIONS IN THE RULES.

In Section II., Clause 1st, after "members," insert "corresponding members," so as to read, "The Institute shall consist of members, "corresponding members, fellows, and honorary fellows."

After Clause 2nd, insert "The name and address of each candidate "for membership, and the names of his proposer and seconder shall "be inserted in the summons for the next monthly meeting, and the "election shall take place by ballot at such meeting. When three-"fourths of those balloting shall have voted in favour of any candi-"date, he shall be declared duly elected, and not otherwise."

Gentlemen not resident in Victoria may be elected corresponding members of the Institute, the mode of election being the same as for ordinary members.

At the end of Section III. insert, "When any vacancy shall occur "in the list of officers, notice thereof shall be inserted in the sum-"mons for the next monthly meeting, and the vacancy shall be filled "up at such meeting."

In Section IV., Clause 1st, erase "and" before Treasurer, and insert after Treasurer the words "Honorary Secretary," so that the clause will read, "The management of the affairs of the Institute "will be vested in the Council, the President, the Vice-President, "Treasurer, and Honorary Secretary, to be *ex officio* members of the "Council."

With reference to the establishment of *Life Memberships*, the Chairman pointed out that this was already provided for in Section VIII. of the Rules of the Institute, but had been overlooked by the Council.

Dr. Wilkie proposed, that instead of £20, as therein fixed, a donation of £10 should constitute a life membership; but the motion was lost.

Dr. Iffla proposed that £15 be the sum fixed on; but this motion was also lost.

A. K. Smyth, Esq., proposed £25; which motion was likewise lost, and eventually the original rule was suffered to remain.

Professor McCoy proposed, and Mr. A. K. Smyth seconded,—

"That R. B. Smyth, Esq., be elected Honorary Secretary."

The motion was accompanied with a very flattering acknowledgment of the abilities of Mr. Smyth.

Dr. Wilkie and others protested against the election, on the grounds that Mr. Smyth had affirmed in Council that he had no time whatever for the performance of the duties of honorary secretary, and had declared his entire inability to retain the office a day longer. He had begged the Council "that no delay might take "place in releasing him from his duties, as he had pressing business "to attend to on his own account;" and the Council were, in consequence, obliged to request Mr. Blandowski to accept the office *ad interim*.

Dr. Iffla supported the statement of Dr. Wilkie, and mentioned that Mr. Smyth had positively refused, in Council, to act in his official capacity.

Dr. Wilkie proposed Mr. Acheson as a most able and talented gentleman, and warmly recommended the advisability of electing him to the office of secretary.

In reply to the statements of Dr. Wilkie and Dr. Iffla, Professor McCoy rose and said that he had received a letter from Mr. Smyth, in which that gentleman expressed his willingness to be elected Honorary Secretary of the Institute.

Dr. Wilkie brought the financial state of the Institute before the notice of the meeting, and stated that the Institute was not in a position to make an annual allowance for clerical assistance. Should, therefore, Mr. Smyth be willing to accept the office of Honorary Secretary under these conditions, he (Dr. W.) would withdraw his proposition for nominating Mr. Acheson.

It was moved by A. K. Smyth, Esq., seconded by C. Hodgkinson, Esq.,—

"That the meeting at once proceed to the election of an Honorary "Secretary."

The resolution being passed, Mr. R. B. Smyth was pronounced by the Chairman as duly elected Honorary Secretary.

The President of the Institute, Captain Clarke (who had joined the meeting at a late hour), handed over to the Chairman a letter from Dr. Scoresby, accompanied by five different pamphlets on the "Magnetism of Iron Ships."

The letter having been read by the Chairman, a vote of thanks was passed to Dr. Scoresby for his valuable contribution.

Mr. Rawlinson gave notice, that at the next monthly meeting of the Institute, he would read a paper "On the Importance of Sani- "tory Works, more especially with reference to Collingwood; with "suggested scheme of remedial works."

Dr. Iffla proposed, and Mr. Dobree seconded,—

"That the thanks of the Institute be given to Mr. Blandowski, for "the kindness with which he had performed the duties of Honorary "Secretary *ad interim*."

The meeting then dissolved at a late hour.

15*th July*, 1856.

Monthly Meeting.

The President in the Chair.

The minutes of the last meeting were read and confirmed.

The Rev. Mr. Guinness, South Yarra, was introduced to the Institute as a new member.

Mr. Rawlinson asked the President what steps had been taken by the Museum Committee, and whether they had come to that meeting prepared to hand in a report?

The President, in reply, stated that he had no objection to that question being asked at that stage of the proceedings; but he held in his hand a copy of the Rules, which clearly rendered it out of order to bring forward any paper or report of which no notice had been given to the Honorary Secretary, and which, consequently, was not on the notice paper. At the same time, if the subject were of deep interest, it would be competent for the meeting to receive the report. He, as Chairman, merely felt it necessary to point out the irregularity.

A long discussion ensued, during which Professor McCoy and the Honorary Secretary supported the views enunciated by the Chairman; and Dr. Wilkie, Dr. Macadam, and Mr. Dobree argued that the importance of the subject rendered it necessary that the Report should be received.

Ultimately it was moved by Dr. Wilkie, seconded by Mr. Dobree, and carried,—

"That the Report of the Committee appointed to watch over the "progress of the inquiry concerning the Museum be read."

The Report was read by Mr. Dobree accordingly.

Dr. Macadam made some remarks on the subject of the Report, and he then moved,—

"That the Standing Committee be empowered to call a public "meeting to consider the question of the removal of the Museum, "and to ascertain the public feeling."

The motion was carried.

A long discussion of a conversational character then ensued.

T. E. Rawlinson, Esq., C.E., then read a paper, entitled, "The "importance of Sanitary Works, especially in reference to Collingwood; with suggested scheme of Remedial Works."

Professor McCoy read a paper, entitled, "Museums in Victoria."

After these papers were read, many questions were asked respecting the drainage in Collingwood, which were replied to by Mr. Hodgkinson; and Professor McCoy afforded a large amount of information regarding the management of museums.

A vote of thanks was passed to Mr. Rawlinson on the motion of Dr. Iffla, and to Professor McCoy on the motion of the Rev. Mr. Guinness.

It was moved by Dr. Wilkie, seconded by the Honorary Secretary, and carried,—

"That the next meeting of the Institute be convened as a special "general meeting, to consider the propriety of admitting Life Mem-"bers on a more extended system than at present provided for by "the Rules of the Institute."

In the course of a discussion on the Report of the Museum Com-

mittee, Professor McCoy, in answer to a question from Dr. Iffla, stated that he considered the retention of the specimens at the University as merely temporary, and that he should use every precaution that the specimens belonging to the National Museum should not become merged with those belonging to the University.

19th August, 1856.

MONTHLY MEETING.

Professor Wilson, Vice-President, in the Chair.

The minutes of the last meeting were read.

Dr. Macadam moved, and Mr. Rawlinson seconded,—

"That the minutes, as now read, be amended by the addition of "the following clause, viz. :—In the course of the discussion on the "Report of the Museum Committee, Professor McCoy, in answer to "a question from Dr. Iffla, stated that he considered the retention of "the specimens at the University as merely temporary, and that he "should use every precaution that the specimens belonging to the "National Museum should not become merged with those belonging "to the University."

A ballot for the election of members was held, and Robert Wadsworth, Esq. (South Yarra), and C. R. Blackett, Esq. (Napier-street), were declared duly elected.

Dr. Macadam read the report of the Museum Committee, and moved its adoption. After some discussion, in which Captain Clarke, Mr. A. K. Smith, Dr. Iffla, Dr. Macadam, and Dr. Wilkie took part, the report was adopted.

On the motion of Mr. A. K. Smith, a vote of thanks to the committee for their services was adopted.

Frederick Acheson, Esq., read a paper on "Motive Power in "Victoria, economically considered."

A discussion ensued, in which Dr. Wilkie, Dr. Mackenna, Mr. A. K. Smith, Mr. Dobree, and Mr. Acheson took part.

On the motion of Dr. Wilkie, a vote of thanks was passed to Mr. Acheson for his interesting paper.

Mr. Dobree asked whether the committee appointed by the Institute had made any report.

The Chairman replied that they had not.

The meeting then resolved itself into a special general meeting.

It was moved by the Treasurer, seconded by Mr. A. K. Smith,—

"That in order to liquidate the existing debt of the Institute, the "fee for Life Membership be reduced to ten pounds, until the sum "of one hundred and twenty pounds shall have been raised."

The motion was carried.

Mr. Rawlinson proposed that in the rules, section 5, clause 5,

after the word "*considered,*" the words "*and reports of committees "to be received and read,*" be added.

The motion was carried.

Mr. Rawlinson proposed to substitute for section 5, clause 7, the following clause, viz. :—

"After the reading of each paper, immediate discussion shall be "allowed on the subject-matter of such paper, previous to the intro- "duction of any other paper or business. Discussions shall be limited "to conversational remarks and questions calculated to elicit facts. "The author of the paper read shall have the right of reply after such "discussion, and the chairman shall have the power to terminate "such discussion with consent of the majority of the members then "present."

The motion was carried.

September 20th, 1856.

MONTHLY MEETING.

Professor Wilson, Vice-President, in the Chair.

The minutes of the last meeting were read and confirmed.

A ballot for the election of new members was held, and Professor Irving, of the Melbourne University, and John George, Esq. (Eastern Hill), were declared duly elected.

A number of letters were read from scientific societies in Great Britain, acknowledging the receipt of the first volume of the Transactions.

William Blandowski, Esq., read a paper entitled "On the Cur- "rincles and Burials of the Aborigines." It was listened to with great interest, and subsequently an animated conversation ensued, when Mr. Blandowski gave vivid descriptions of some of the manners and customs of the native inhabitants. Professor Wilson, Clement Hodgkinson, Esq., Dr. Iffla, and other gentlemen, took part in the conversation.

Certain specimens of Rocks and Minerals from the Arabian desert, and specimens of Shells and Sponges from the Holy Land, which had been presented by J. B. Were, Esq., were laid before the meeting.

October 15th, 1856.

MONTHLY MEETING.

The President in the Chair.

The minutes of the last meeting were read and confirmed.

A ballot for the election of a new member was held, when the President declared that Charles Todd, Esq., was duly elected as a corresponding member of the Institute.

Robert Brough Smyth, Esq., the Honorary Secretary, then read a paper "On the Phenomena of Hailstorms in Victoria." A discussion ensued, when the Rev. Mr. Bleasdale, Ludwig Becker, Esq., and others, communicated much useful information respecting these meteors.

The Rev. Mr. Bleasdale presented the Institute with a specimen of Black Glass and Charcoal obtained from the residuum of burnt corn stacks at Mount Emu, and Alfred Selwyn, Esq., presented interesting specimens of Fossil Graptolites from the neighbourhood of the Deep Creek, the first discovered in the colony.

November 19th, 1856.

Monthly Meeting.

Professor Wilson, Vice-President, in the Chair.

The minutes of the last meeting was read and confirmed.

A ballot for the election of new members was held, and Captain Cadell was elected a corresponding member, and S. Elliott, Esq., and Thomas Elliott, Esq., were elected members of the Institute.

Professor Irving, and Robert Wadsworth, Esq., two new members present for the first time, were introduced by the President.

A letter was read from Mr. Sprague, of the Boston Natural History Society, forwarding 400 specimens of Plants.

A letter was read from the Linnæan Society of London, transmitting a volume of their Proceedings.

A pamphlet was laid on the table, which had been forwarded by the Institute of Civil Engineers of England.

Dr. Wilkie read a report in reference to a collection of Shells offered to the Institute by Messrs. Elliot.

Dr. Wilkie then read a paper "On a new method of Propulsion," illustrated by a very beautiful model. The writer explained his invention as one intended, under certain circumstances, to supersede the use of the paddle and screw in steam ships.

A discussion followed the reading of this paper, limited to conversational remarks, in which Mr. Rawlinson, the Rev. A. Morison, Professor Wilson, and the Honorary Secretary took part; thereupon Professor Wilson left the Chair, when it was taken by Dr. Wilkie.

Professor Wilson then read his paper "On the steps taken in "England to provide a telescope for observing the Nebulæ of the "Southern Hemisphere."

The writer pointed out the advantages that would accrue to this colony and to the scientific world by investigating sidereal astronomy in this part of the world, and recommended that steps should be taken to provide a telescope.

Professor Hearn rose, and expressed his conviction that the arguments used by Professor Wilson, who is himself a practical astronomer, were of great weight and importance, and that instrumental

means should be obtained to carry out the views named in the valuable paper just read.

After other gentlemen had expressed similar views, it was proposed by Dr. Iffla, seconded by Mr. Smyth, and carried :—

"That a committee, consisting of the Hon. Capt. Clarke, Pro-
"fessor Wilson, Professor Hearn, the Rev. A. Morison, and Dr.
"Iffla, be empowered to take such steps as may seem expedient,
"to induce the Government to place upon the estimates a sufficient
"sum to establish an Astronomical Observatory in Victoria."

Mr. Becker's paper on various subjects of Natural History was postponed until the next Monthly Meeting.

The President announced a valuable collection of Shells presented to the Institute by Messrs. Elliott on their election, in consideration of which the Council intended to remit the usual payment by them as Life Members.

A vote of thanks was passed to Professor Wilson and Dr. Wilkie for their valuable papers.

December 18th, 1856.

Monthly Meeting.

Dr. Iffla in the Chair.

The minutes of the last meeting were read and confirmed.

Ludwig Becker, Esq., read three papers on the following subjects of Natural History, viz. :—

1. "On the Nest and Egg of the 'Menura Superba,' Lyre Bird,
"illustrated by the nest, egg, and young of the bird."
2. "Tenacity of life in the 'Ornithorynchus Paradoxus.'"
3. "On a new Metal found in basalt."

After the conclusion of Mr. Becker's remarks, a conversation ensued, in which the Honorary Secretary, Dr. Mackenna, Dr. Iffla, and other gentlemen took part.

In accordance with the provisions of section 3 of the rules, the Council recommended the following gentlemen as officers for the ensuing year.

President.

The Honorable Andrew Clarke, Captain R.E., M.P., &c.

Vice-Presidents.

Professor Wilson, M.A.
Clement Hodgkinson, Esq., C.E.

Treasurer.

David E. Wilkie, Esq., M.D.

Honorary Secretary.

Robert Brough Smyth, Esq., C.E, F.G.S.

Council.

Dr. Iffla.
Rev. A. Morison.
Ludwig Becker, Esq.
Professor Hearn, L.L.D.
Professor Irving.
Professor McCoy, Hon. Fell. Can. Phil. Soc., F.G.S.
A. R. C. Selwyn, Government Geologist.
John Macadam, Esq., M.D.
Rev. John Bleasdale.
Thos. E. Rawlinson, Esq., C.E.
Rev. William Baxter, M.A.
William Blandowski, Esq.

It was then proposed and seconded—

"That the name of Dr. Wilkie be added to the list of Vice-Pre-
" sidents for election."

"That the names of the Rev. Mr. Guinness, Dr. Mackenna,
" A. K. Smith, Esq., and Frederick Acheson, C.E., be added to the
" Council for election."

Dr. Wilkie then rose and called the attention of members to the present unfortunate condition of Mr. Wekey, a former officer of this Institute. Dr. Wilkie alluded to the exertions made by Mr. Wekey in former times in behalf of the Philosophical Society, and he considered that the Philosophical Institute was bound, in some measure, to take Mr. Wekey's misfortunes into consideration. Dr. Wilkie would move,—

"That the sum of twenty pounds be voted to Mr. Wekey, in con-
" sideration of past services."

Dr. Goethe seconded the motion, and cordially approved of help being given to Mr. Wekey.

Mr. Smyth said that Dr. Wilkie could not surely ask the meeting to vote away the public money in this manner. He contended that notice ought to have been given. At the same time, he (Mr. S.) would not prevent Dr. Wilkie's object, but would privately contribute, if the members present were of his opinion.

Dr. Wilkie then withdrew his motion, and a private subscription was entered into.

ANNUAL GENERAL MEETING.

SECOND REPORT OF THE COUNCIL OF THE PHILOSOPHICAL INSTITUTE OF VICTORIA.

Read 14th January, 1857.

SECOND REPORT *of the* COUNCIL *of the Philosophical Institute of Victoria, presented to the Members at the Annual Meeting on the* 14*th of January,* 1857.

The progress made by the Institute during the past year may be measured by the undiminished activity of the members; the numerous interesting subjects brought before each meeting; the numerical strength of the body; and the condition of the funds.

The locality of the National Collection of objects of Natural History, has occupied the attention of the Institute. A Committee was appointed to investigate the subject, and we have to refer to their Reports for an account of their proceedings relative to this matter.

The papers read during the past year have been of considerable interest, and some of great utility. The Council would wish to bring prominently before the Members the desirability of each of them striving to contribute useful facts in any department of science.

Much obscurity particularly rests on many objects of Natural History, both animal and vegetable, which have not yet been narrowly watched and reported upon; and such labours will always prove interesting, and not seldom practically beneficial.

It is also desirable that efforts should be made to obtain knowledge respecting the habits of, and the climate fitted to, the animals which are so eminently useful, and almost indispensable in countries of similar physical character to ours. This was made the subject of

a special enquiry by a Sub-Committee appointed at a General Meeting, but there are difficulties in the way of such Sub-Committees usefully prosecuting enquiries to which the Council would generally direct attention. Sub-Committees were appointed to enquire into the gold-mining operations, and to consider the advantages and expediency of works for irrigation, but none of these Sub-Committees have brought up a report, and the Council is impressed with the belief that the cause of this is due to the impossibility of the Members generally devoting any large portion of their time to such enquiries.

The Government, however, have taken up the matter of the Mining Commission, and it proposes to enquire thoroughly into the subject of mining, as practised in this country.

While alluding to the papers, the Council refers with pleasure to the exertions now being made towards the erection of an Astronomical Observatory in Victoria, provided with a large reflecting telescope. The Council particularly refers to the courteous manner in which the Hon. the Chief Secretary received the deputation appointed to wait upon him, and you will rejoice to learn that the Government then expressed itself most favourably respecting the scheme for an Observatory, and will, at the proper time, seek to further the views of the Members as may seem most expedient.

The Council has much pleasure in calling your attention to the cordial manner in which the learned Societies in Europe and America have responded to the invitations to exchange Transactions. Some works of value have already been received from some of them, and many have promised to forward their Transactions regularly.

A Grant of £250 was made to the Institute by the late Legislative Council. This sum was very inadequate to enable the Institute usefully to perform its important functions. But, even for this sum, small and inadequate as it was, we regret to state that no provision appears to have been made in the present year. We had hoped that under a more liberal and popular system of Government the claims of Science would have met with a far different recognition.

While the Council, in reviewing the Proceedings of the past year, finds many subjects for congratulation, it cannot but record its regret, that no permanent place has yet been provided for the General Meetings of the body.

The Council is well aware that it would be unwise to attempt to build suitable rooms while the means are crippled and calls for other objects most urgent; at the same time, in now resigning office, the Members would wish to see their successors exert themselves most strenuously towards accomplishing this.

If the Institute is not able to build or purchase suitable rooms

for some time to come, it could perhaps obtain the use of a central building where its books and property could be placed, so as to be accessible to the Members, and not, as at present, in the private keeping of one of the Officers.

In commencing another year, the Council looks forward with confidence. The ardour of many of the Members, their desire to further the objects of the Society, their common labours directed to so many branches of Natural Science, their love of study for its own sake, and their pride in the recognition by the older nations of the claims of this Institute, are sufficient to secure a result creditable alike to the Colony and to ourselves, as labourers in the domain of Science.

STATEMENT OF RECEIPTS AND EXPENDITURE OF THE PHILOSOPHICAL INSTITUTE OF VICTORIA,

From June, 1855, to 31st December, 1856.

RECEIPTS.

1855.	Subscription—Dr. Berndt, ..	£2	2	0
	Half working expenses paid by Philosophical Society, ...	11	4	5
	Ditto Victorian Institute, ..	10	4	5
				23 10 10
	Dr. balance, ...			212 19 1
				236 9 11
1856.	Sixty-six annual members, @ 42s.,	138	12	0
	F. C. Christy, subscription, 1855.	3	3	0
July 24.	Grant by Colonial Government, ..	250	0	0
	Seven Life Members, @ £10, ..	70	0	0
				£461 15 0

DAVID E. WILKIE, M.D., Hon. Treasurer.

EXPENDITURE.

1855.	Balance due by Philosophical Society to Treasurer, ...	£1	18	11	
	Loss on publication of the Transactions of the Philosophical Society for 1855, adopted by the Philosophical Institute January, 1856, ..	187	14	2	
	Stamps, stationery, &c., ...	10	3	4	
	Clerical assistance, ...	15	2	0	
	Printing circulars, ...	7	0	0	
	Lighting, ...	13	13	6	
	Advertising, ...		18	0	
					236 9 11
1856.	Balance,	212	19	1	
Jan.	Secretary per petty cash, ...	10	0	0	
Feb. 14.	Expenses of collection, ...	2	2	0	
April 28.	W. Runting, bookbinding, ..	9	6	8	
May 9.	Goodhugh & Hough, for printing,	16	13	0	
June 12.	Printing, ...		12	6	
May 9.	Bloxam, for attendance, ...	5	2	6	
Sept. 10.	Ditto ditto	7	17	6	
June 21.	Clerical assistance, ...	1	0	0	
Oct. 14.	Ditto	3	0	0	
June 12.	Stamps and stationery, ...		19	0	
„ 21.	Rent for one year, ...	10	0	0	
Dec. 2.	Messenger, ...	5	0	0	
					284 12 3
	Credit balance, ...				177 2 9
					£461 15 0

Examined and found correct, Feb. 4, 1857.

W. P. WILSON,
CHARLES FAREWELL, } Auditors.

APPENDIX.

Resolutions passed at a Public Meeting, held in the Mechanics' Institution, on the 26th day of July, 1856, for the purpose of considering the advantages to be derived from the establishment in Melbourne of a National Museum, and of adopting measures to prevent the removal of the existing Museum to the University, with the view of establishing it in a more central part of the city. Henry Langlands, Esq., in the Chair.

After an address from Dr. D. E. Wilkie, it was

Moved by Wm. Westgarth, Esq., seconded by Dr. Macadam, and carried unanimously,—

"That this meeting is strongly impressed with the great importance "of a National Museum, both as a means of education for all classes, "and also as an absolute requirement for diffusing among the commu- "nity a correct knowledge of the products and resources of Australia "and other countries."

Moved by Dr. McCarthy, seconded by the Rev. Mr. Bleasdale, and carried unanimously,—

"That this meeting having learnt, with deep regret, that orders have "been issued for the immediate removal of the present Museum to the "University buildings, records its strong disapprobation of so remote "and inconvenient a locality."

Moved by Dr. Embling, seconded by Sizar Elliot, Esq., and carried unanimously (with the exception of two dissentients),—

"That this meeting regards it of vital importance that the Public "Museum should continue as an independent national institution, and "therefore deprecates the removal to any locality, where it may by any "possibility become solely an University collection."

Moved by James Service, Esq., seconded by Mr. Alderman Clowes, and carried unanimously,—

"That in the opinion of this meeting, it is imperative on the Govern- "ment immediately to provide suitable accommodation, in a convenient "and central locality, for the reception of the highly valuable collection "already formed at the public expense, and that they should, at the "earliest possible period, carry out their original intention of erecting a "suitable building for the National Museum, in connection with the "Public Library Building."

Moved by Thomas E. Rawlinson, Esq., C.E., seconded by Dr. Richard Eades, and carried unanimously.—

"That a deputation, consisting of the Mayor of Melbourne, Dr. "Macadam, Mr. Service, Mr. Westgarth, Mr. Hood, Dr. Wilkie, Mr. "Langlands, Rev. Mr. Bleasdale, Mr. Thomas Rae, Dr. Embling, Rev. "Mr. Jones, Dr. Iffla, Mr. O'Shanassy, Mr. Clowes, Dr. Eades, and "Mr. Rawlinson, the mover (with power to add to their number), be "appointed to draw up a memorial embodying the resolutions passed "at this meeting, and to lay the same before his Excellency the Officer

" Administering the Government, the deputation afterwards to continue " to act as a committee, and take such further steps in this matter as " they may consider necessary."

Report of the interview granted on the 1st August, by his Excellency the Acting-Governor, to the Deputation appointed at the Public Meeting, held in the Mechanics' Institution, on the 26th day of July. Copied from the Melbourne *Argus* of the 4th August, 1856.

" PUBLIC MUSEUM.

" The deputation, appointed at the public meeting held on Saturday, " the 26th ult., to lay before his Excellency the resolutions passed at " the meeting, relative to the removal of the public Museum to the " University, had the honor of an interview with his Excellency, at " the Government House, William-street, on Friday last, at one " o'clock, p.m.

" The Deputation, consisting of Messrs. Macadam, Wilkie, Langlands, " Ffila, Clowes, Bleasdale, Service, Hood, Jones, and Rawlinson, were " introduced by the Private Secretary.

" The Colonial Secretary, Mr. Haines, was present during the interview.

" Mr. Langlands, as chairman of the public meeting, opened the " business by requesting permission to submit the memorial and reso- " lutions.

" His Excellency paid marked attention to the resolutions and memo- " rial during the reading, and in answer remarked, that the Govern- " ment sympathised with the feelings and principles embodied in the " resolutions, and felt the full importance of the question. That unfor- " tunately the Government have no funds available at present for pro- " viding the accommodation required, whether it be of a temporary or " permanent kind; and as a consequence, the museum specimens were " removed temporarily to the University. This removal, however, " was *only* temporary, until such time as the Legislative Council shall " provide means for erecting suitable buildings. When the Council " assembles, the Government will be disposed to promote the views set " forth in the resolutions, in reference to providing a more central and " suitable place.

" The deputation called His Excellency's attention to the fact, that " one of the members of the council of the University had stated, at " the public meeting, that the Museum was given to the University in " trust.

" His Excellency and the Colonial Secretary stated distinctly that " they understood and considered the removal of the Museum to the " University as only of a temporary nature, until the Legislature shall " vote the necessary funds for constructing a proper building for the " reception of the specimens, and immediately that funds were provided, " no time should be lost in erecting a suitable place for them.

" The deputation urged upon His Excellency the great delay that " must occur by waiting for such an authority, and asked if the Govern- " ment would authorise the removal of the Museum from its present " position to a more central situation, if a suitable building could be " obtained for the purpose temporarily, either through the agency of " this deputation or otherwise.

" His Excellency did not feel justified in committing himself to an " answer, unless the questions were put in a more tangible shape, and " more complete details of the scheme were furnished.

"The Colonial Secretary saw a serious difficulty in the way, namely, "the impropriety of handing public property over to the care of private "persons, or even to such a society as the Philosophical Institute.

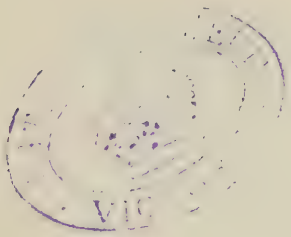
"The deputation met this objection by suggesting a special trust of "three, five, or more gentlemen, as in the case of the Public Library "and University, and also that immediate steps should be taken to "secure the land between the Public Library and Russell-street, for the "purpose of a Museum. The deputation also alluded to a report that it "is intended by the Government to appropriate a portion of this land "for a Police Barracks, and expressed their opinion of the great desira- "bility of preserving the whole of the ground intact, for the purposes of "the Library and Museum.

"The deputation also called His Excellency's attention to the insinua- "tions that had been made against this movement, as one antagonistic "to the University. The deputation strongly repudiated such a senti- "ment; for both they and the public generally entertained a high "opinion of the University and its Professors, as the head of the educa- "tional establishments of the colony; but the deputation wished dis- "tinctly to mark the line of distinction which exists between the purposes "for which an University is endowed and founded, and the purposes "and uses of a public Museum—that whilst each are of the highest im- "portance as public institutions, the means of each for attaining a given "end are essentially different, and hence the two cannot be combined "without one becoming subservient to the other.

"After thanking His Excellency for the urbane and courteous recep- "tion he had given them, the deputation withdrew.

"NOTE.—Although the deputation have not succeeded in obtaining "an immediate restitution of the public Museum, they have obtained a "distinct statement from both His Excellency and the Colonial "Secretary that the removal is regarded, and has been allowed, purely "as a temporary one, until funds are provided for a proper building."

GOODHUGH & HOUGH, Printers, Flinders-Lane East, Melbourne.



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